SCIENTIFIC AMERICAN

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IMPROVED CALORIC ENGINE.

Caloric engines have long been used by the Trinity Board to provide power for working siren fog signals in connection with their lighthouses in England. They have generally been in the past of the horizontal type, but lately a new pattern, which we illustrate from *Engineering*, has been brought out; and as the entire work of the motor consists in driving air-compressing pumps, this form of engine should give very good results. At one end of a beam stands the retort or furnace with the motor cylinder, and at the other end stand three pumps. One of these forces air into the furnace, a second supplies the receiver of the fog signal, while the third, which is smaller than the second, performs the same office, when it is desired to raise the pressure to a point too high for the larger pump to accomplish. As fogs come on very suddenly, and give so little warning that it is often impossible to get the engine into action before the vision is entirely obscured, it is customary to keep a store of air in the receiver at two or three times the usual working pressure, and it is from the accumulation of this pressure that the smaller pump is provided.

The furnace is a closed receiver, and is fed with coke. Air is pumped into it at a pressure of about 30 lb. to the square inch, part being delivered below the fuel and part above. That part which goes below rises through the incandescent coke, and appears at the surface as carbonic oxide. Here it meets the upper air supply and burns with a fierce bright flame, producing very hot gases, which are admitted to the cylinder and there expand, driving the piston before them. From experiments made by Mr. C. Ingrey with engines of this kind, it appears that they consume from 2¼ lb. to 2½ lb. of coke per brake horse power per hour, and thus provide power very economically.

The engine is regulated by a governor, which varies the proportion of air admitted above and below the fuel, and thus alters the temperature of the gases admitted to the cylinder. The distributing valves are of the conical type, worked by tappets, and the fall is regulated by an air cushion.

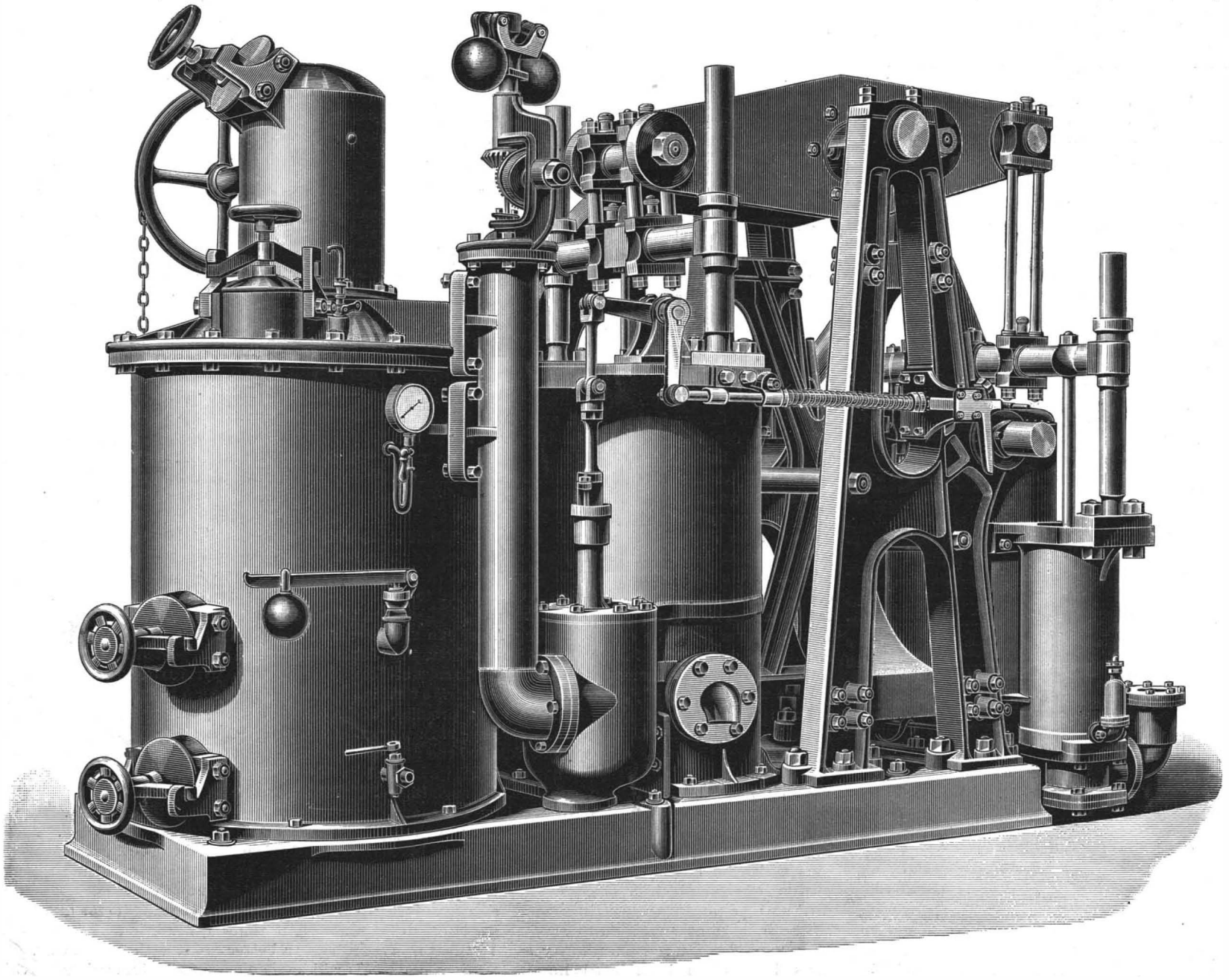
These engines, for there are a pair, have been constructed by the Pulsometer Engineering Company, Limited, London, for the Northern Lights Commissioners, and will be erected on a lightship, probably at the North Carr. Each engine is nominally of six horse power, but actually gives ten horse power. The motor cylinder is 24 in. in diameter, the air pump 18 in., and the compressing pumps 9 in. and 5 in. respectively, all with a stroke of 18 in.

Naval Architecture During the Last Half Century.

The annual lecture under the auspices of the Greenock Philosophical Society, to commemorate the birth of James Watt, was delivered in the Watt Lecture Hall, Greenock, on January 14, by Mr. Robert Duncan, shipbuilder, Port Glasgow. The title of Mr. Duncan's paper was "Evolution in Naval Architecture during the Reign of Queen Victoria." After referring to the early history of marine engineering, and to the intimate connection of Greenock and the Clyde with its initial stages, Mr. Duncan went on to say that up to the date of her Majesty's accession in 1837, no systematic attempt at ocean navigation by steam had been made. In 1812 steamship building began, but it was not till 1838 that the first Atlantic steam communication began. The Sirius and the Great Western made the voyage to and from New York at the same time, in the middle of that year, in fourteen and seventeen days respectively, under steam all the way. Mr. Duncan then traced rapidly the evolution of the iron ship, through the various modifications of design and proportion, and the simultaneous and consequent evolution of crafts to adapt themselves to the rapidly changing conditions. Mr. Duncan also described the influence upon the forms of ships of maritime law and of Lloyd's rules—evolution in size from the short square boxes of the early periods to the long narrow vessels of to-day; the Enterprise, for example, the first steamer to make the voyage to India by the Cape of Good Hope, being only 122 feet long, while now the cargo carrying steamer is over 400 feet long, and the express passenger ocean steamer over 500 feet. Mr. Duncan considers it possible that, ere her Majesty's reign closes, the Flying Scotchman of the sea will reach a length of 800 feet, and a speed of twenty-five to thirty miles an hour. The evolution of the man-of-war was next described, an interesting sketch given of the science of naval architecture, and a bibliography of the subject.

A Three Cylinder Locomotive.

The Dunmore Iron and Steel Company, at Dunmore, Pa., has a small locomotive in use switching in its yards which is of a novel pattern. It is thus described by the superintendent of the works: "This little engine has three 8 × 12 in. steam cylinders, four 33 in. driving wheels, two outside connecting and parallel rods, and one inside connecting rod. No balancing is needed in driving wheels. The engine has six exhausts to a revolution, and the effect on the fire is good. It is claimed that by setting the cranks at an angle of 120 degrees the slip is reduced to a minimum. This engine makes 30 miles an hour on a 40 ft. grade easily, with a light load, and is considered a good machine by those who have run her. Its weight is about 12 tons."



IMPROVED BEAM CALORIC ENGINE.

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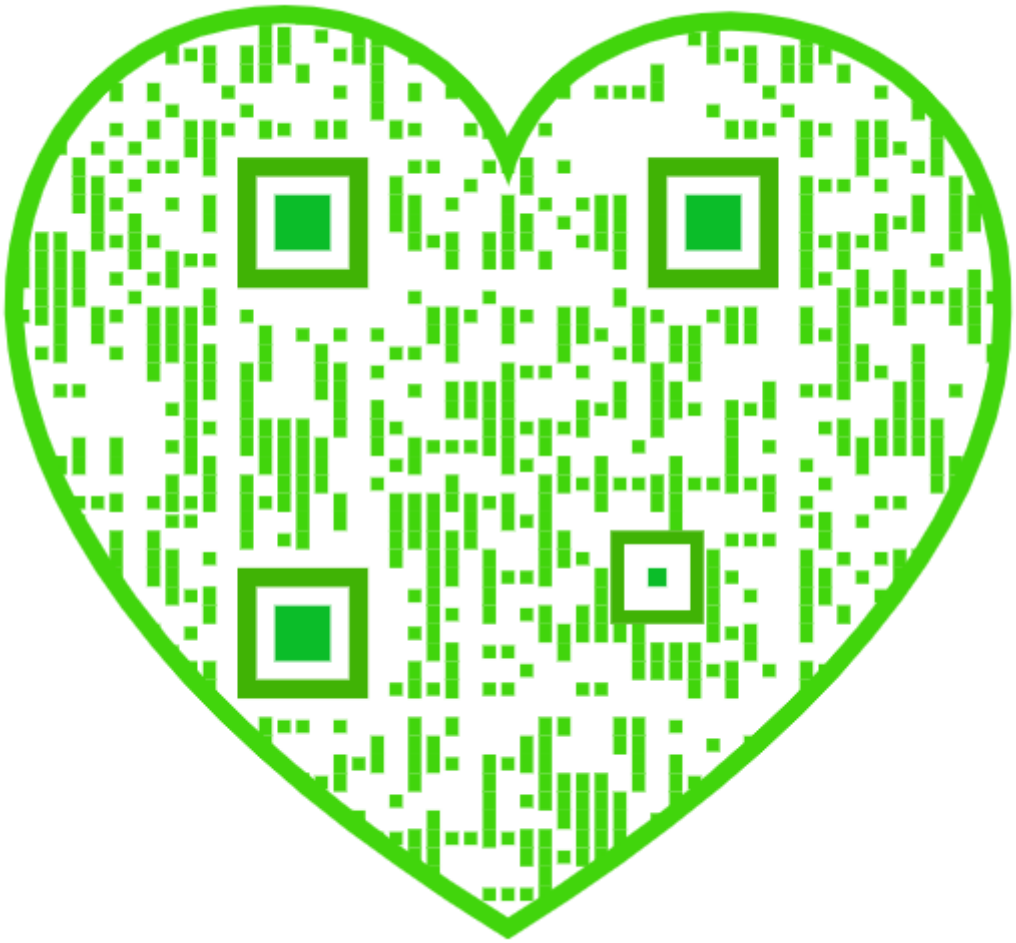

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NEW AMENDMENT OF THE DESIGN PATENT LAW.

An amendment of the patent law relating to design patents has lately passed both houses of Congress and received the approval of the President. The object of the amendment is to correct a defect in the law, which prevented the patentee from collecting damages in cases of infringement.

Under the old law, the Supreme Court held that in the case, for example, of a carpet manufacturer who complained of an infringement of his design or pattern of carpet, the complainant must clearly prove what portion of the damage, or what portion of the profit made by the infringer, was due to the use of the patented design. It was practically impossible to make this showing. Hence the infringer could imitate the patented design without liability, and the law was a nullity.

Under the provisions of the new law, the infringer is obliged to pay the sum of $250 in any event; and if his profits are more than that sum, he is compelled, in addition, to pay all excess of profits above $250 to the patentee. It is believed that the penalty of $250, irrespective of profits, will put a stop to the wholesale system of infringement heretofore carried on by unscrupulous persons.

The following is the text of the new law:

An act to amend the law relating to patents, trade marks, and copyright.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That hereafter, during the term of letters patent for a design, it shall be unlawful for any person other than the owner of said letters patent, without the license of such owner, to apply the design secured by such letters patent, or any colorable imitation thereof, to any article of manufacture for the purpose of sale, or to sell or expose for sale any article of manufacture to which such design or colorable imitation shall, without the license of the owner, have been applied, knowing that the same has been so applied. Any person violating the provisions, or either of them, of this section shall be liable in the amount of two hundred and fifty dollars; and in case the total profit made by him from the manufacture or sale, as aforesaid, of the article or articles to which the design, or colorable imitation thereof, has been applied, exceeds the sum of two hundred and fifty dollars, he shall be further liable for the excess of such profit over and above the sum of two hundred and fifty dollars; and the full amount of such liability may be recovered by the owner of the letters patent, to his own use, in any circuit court of the United States having jurisdiction of the parties, either by action at law or upon a bill in equity for an injunction to restrain such infringement.

SEC. 2. That nothing in this act contained shall prevent, lessen, impeach, or avoid any remedy at law or in equity which any owner of letters patent for a design, aggrieved by the infringement of the same, might have had if this act had not been passed; but such owner shall not twice recover the profit made from the infringement.

Approved, February 4, 1887.

ARE STEEL GUNS REALLY SUPERIOR?

Admiral Porter said recently that there was little hope of building fast war ships as long as the Bureau of Steam Engineering designed the engines, for that, such was the influence of interested persons, it was not free to choose the best devices. Whoever is familiar with the workings of the Ordnance Bureau will admit that this, too, is similarly controlled. Long ago it pronounced in favor of steel guns, and like a judge who records his decision and then asks to hear the evidence, this bureau has been listening unmoved to the most convincing testimony regarding the relative efficiency of cast iron guns.

The importance of this question of steel *vs.* cast iron guns will be appreciated when it is explained that it would take at least five years after the passage of an appropriation before the first steel gun could be turned out, while only a twelvemonth would be required to establish a cast iron gun plant.

It has never been the custom among American mechanicians to blindly follow the lead of others, but rather to work untrammeled by traditions; to carefully note what has already been done, and to strike out anew in whatever direction gives the most promise. Experienced gun makers and artillerists have recently admitted that the steel rifle has not fulfilled the promises made for it. The Krupp guns, of which we hear so much, have never yet been subjected to such high pressures as have been applied to cast iron guns, and experience has shown it would not be safe to put them through such tests. Indeed, the cast iron smooth bore guns which have been converted into rifles by the insertion of wrought iron rifled cylinders have been fired under a pressure fully three times as great as it has been thought advisable to subject steel guns of the same caliber to. An authority says: "Cast iron guns have often been fired hundreds of rounds under pressure of nearly seventeen tons to the square inch of bore, yet there has never been a failure, nor a sign of one. The United States has now a 12½ in. cast iron rifle constructed on the same plan as the 8 in. converted rifle. This gun was made ten years ago, as an experiment. It has been fired with charges as high as two hundred pounds of hexagonal or quick powder (as compared with powder now considered suitable), and is still serviceable. The United States has another experimental 12 in. rifle, entirely of cast iron. It has been fired more than a hundred rounds with high power charges (265 pounds powder, 800 pound shot), and is still serviceable."

Curiously enough, the experiments with these guns ceased at the very time when there was the most reason for continuing them, to wit, while they were giving evidence of their ability to stand a long series of continuous rounds. The mode of testing a high pressure gun, upon which all authorities agree, is to fire it, round after round, until it bursts or shows weakness. There is authority for the statement that there is not a 12 inch steel gun in Europe which has been fired two hundred rounds, and yet, just as soon as these cast iron guns gave promise of withstanding successfully such a test, a peremptory order came from the Ordnance Bureau to cease firing and stop further experiment.

The failure of steel guns in Europe is frequent, though there is good reason for the belief that we only hear of a tithe of them, the balance being kept secret. Only the other day a big steel gun exploded at the muzzle, on the French trial grounds, and news comes that both in the war ships Collingwood and Ajax a number of steel guns have been condemned.

Because of these facts it is not at all surprising that the majority in the House of Representatives, though willing to appropriate money for guns, are averse to having the outlay controlled by the Ordnance Bureau, which is wedded to the steel gun theory and others not much better sustained.

THE COCAINE HABIT.

A number of cases of confirmed cocaine habit have recently been reported. While some of them lack confirmation, it is certain that several physical and mental wrecks have been caused by the excessive use of this alkaloid. The South American Indians, long famous as coca eaters, seem as a rule not to succumb to its effects. They use the dried leaf, which they chew, previously introducing a small amount of alkali, to set the cocaine free. In civilized countries the alkaloid as a chloride is usually employed, and is administered by hypodermic injection.

The practice of using it habitually in excess is hitherto reported as almost confined to physicians. Its effects upon its victims are very sad. The brain becomes permanently or for a period affected, a species of lunacy being produced. Just as in the case of opium eaters, the moral nature is undermined. One doctor was reported, so recently as to be within the memory of our readers, as having turned on the gas in a drug store where the alkaloid was refused him, with the design of asphyxiating the clerk, in which attempt he nearly succeeded. Another doctor, within a space of some sixteen months, has gone insane from the cocaine habit and has been removed to an asylum, leaving his wife also ill from the effects of the same drug, with which he had experimented on her.

If the cases continue to multiply, there may be room for questioning the utility to man of the discovery of this anæsthetic. It is doubtful if all the services in local anæsthesia rendered by it can compensate for the ill it has already done.

Pyrofuxin—a New Tanning Substance from Coal.

A new extract of coal is being introduced in Germany for industrial purposes, especially for tanning leather and disinfection generally, to which the name "pyrofuxin" is given by the discoverer, Professor Paulus Reinsch, of Erlangen, Bavaria. Unlike the generality of such compounds, this new material is not a derivative of coal tar, or of any of the distillates of coal, but is obtained directly from coal itself. Pit or bituminous coal contains most of it, and is prepared for treatment by being broken into nuts. The crude pyrofuxin is extracted by repeated boilings in a solution of caustic soda. The pyrofuxin enters into solution, and is allowed to stand for a time. It is then poured off, and a carbonic acid gas is passed through it. The resultant liquor has a specific gravity of 1·025 to 1·030, and holds from 10 to 15 grammes of pyrofuxin to the liter. In its purified form the compound is a fine, non-triturable substance, without taste or smell, non-poisonous, and in appearance like catechu. Some Russian coals contain 18 per cent of pyrofuxin. After the extraction of this material the coal remains combustible. It is described as being one of the most powerful and effective antiseptics known to science. On this account it is expected to be most valuable for tanning, as being twenty-eight times quicker in action than bark, and producing a better result at decreased cost.

It will be soon enough to give credence to this alleged leather tanning agent when specimens of good leather are produced.

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Weight and Power of Modern Guns.—Table of Armstrong Guns.

Gun.	Caliber.	Weight.	Total Length of Gun.	Length of Bore.	Weight. Charge.	Weight. Projectile.	Muzzle Velocity.	Total Energy.	Energy per Inch of Shot's Circumference.	Energy per Ton Weight of Gun.	Thickness of Wrought Iron Plate the Shot is Capable of Perforating.
in.	in.	tons.	calibers.	in.	calibers.	lb.	lb.	ft. per sec.	ft. tons.	ft. tons.	ft. tons.	in.
4·7234	4·7234	2·5	24	112·7	22	12	40	1,680	783	522·0	59·1	7·0
4·7234	4·7234	2·2	35	165·3	33	16	40	2,073	1,198	532·4	81·3	9·1
6·0	6·0	4·0	28	166·4	26	42	80	2,060	2,354	588·5	125·7	11·6
6·0	6·0	4·5	32	192·0	30	45	100	1,940	2,610	580·0	139·4	12·2
6·0	6·0	5·5	37	222·0	35	60	100	2,146	3,193	580·5	170·5	13·5
7·0	7·0	7·0	28	196·0	26	60	120	2,050	3,497	499·3	160·2	13·0
7·0	7·0	8·0	32	224·0	30	75	145	2,020	4,075	479·4	196·6	14·1
8·0	8·0	9·0	28	259·0	35	80	145	2,140	4,604	511·5	210·9	14·9
8·0	8·0	11·5	28	222·5	26	120	180	2,177	5,915	514·3	236·9	15·8
8·0	8·0	12·5	32	256·0	30	120	200	2,157	6,452	516·6	258·4	16·5
8·0	8·0	14·0	37	296·0	35	130	210	2,226	7,280	520·0	291·5	17·5
9·2	9·2	19·0	28	257·6	26	175	320	2,060	9,412	495·3	327·5	18·5
9·2	9·2	21·5	32	287·3	30	200	380	2,035	10,923	508·0	390·1	20·0
9·2	9·2	24·0	37	340·4	35	200	380	2,375	14,900	616·6	515·0	23·2
10·0	10·0	25·0	28	274·0	26	230	460	1,910	11,383	455·3	394·2	19·5
10·0	10·0	27·0	32	320·0	30	270	470	2,185	15,560	576·3	497·9	22·8
10·0	10·0	30·0	37	370·0	35	270	500	2,213	16,979	566·0	549·3	23·8
12·0	12·0	43·0	28	331·0	26	330	700	2,087	21,141	491·6	569·1	24·2
12·0	12·0	46·0	32	384·0	30	400	850	2,117	24,861	540·4	662·2	26·2
12·0	12·0	51·0	37	444·0	35	450	850	2,205	28,695	562·0	768·6	28·1
16·25	16·25	93·0	28	455·0	26	850	1,800	2,106	55,377	595·4	1,088·7	33·5
16·25	16·25	110·0	32	520·0	30	900	1,800	2,216	61,200	556·4	1,203·2	35·2
18·25	18·25	127·0	37	601·3	35	900	1,800	2,295	69,745	517·6	1,292·6	36·9
17·0	17·0	100·0	28	468·0	26	827	2,000	1,832	51,790	517·9	973·1	31·4
17·0	17·0	116·0	32	544·0	30	1,000	2,000	2,190	66,512	573·3	1,249·7	35·8
17·0	17·0	127·0	37	629·0	35	1,000	2,000	2,255	70,530	514·7	1,325·0	37·0

Castner's New Method for Producing Sodium.

This new method, heretofore mentioned by us, is now being successfully worked in London, and is thus described in *Engineering:*

Up to the present this novel method of manufacture has been kept rather secret, but now, owing to the success achieved by a plant erected and worked on a commercial scale, we are enabled, through the courtesy of Mr. H. Y. Castner, to lay before our readers an outline sketch of the method of operation which is followed, and which we have seen carried out with success at his works, 65 Belvidere Road, Lambeth. Few persons outside of the chemical profession are aware of the commercial existence of the metal sodium or of its uses, and even among those following that profession but little is known, except that it is used in the manufacture of aluminum, and is very expensive. Much has lately been published in various scientific journals throughout the world upon the subject of alleged new processes, whereby that highly interesting metal—aluminum—might be cheaply produced without sodium, and thus be made to take in the commercial world a place to which its varied valuable properties entitle it. So far nothing has resulted from these numerous so-called discoveries, and at the present time the only process in use whereby aluminum can be produced is that devised by and due to Deville's ingenuity.* This process has been called the sodium process, apparently to distinguish it from others, but seeing that it is the only process which has ever proved practical, it is somewhat of a mystery why it needed to be so distinguished.

The late Dr. Walter Weldon, in a paper read before the Society of Chemical Industry a few years ago, clearly resolved the great question of cheaply producing aluminum, and showed by argument that this end was only to be gained in either of the two following directions, namely, first, by the production of cheap sodium and the employment of Deville's process, and second, by the discovery of a substitute for sodium, which has hitherto given to aluminum its excessive cost in production. After twenty-five years of research by some of the best scientists of the present age, no substance has been found that will replace sodium, and although every known substance has, at various times, been proposed, none has been successful. So discouraging has been the research, that those familiar with the subject have almost abandoned hope of ever seeing aluminum cheaply manufactured by chemical processes, believing also that Weldon's first proposition was an impossibility.

It is not the purpose of this article to enter into a lengthy discussion of Mr. Castner' process of producing sodium, as Mr. James Mactear, F.C.S., is about to prepare a scientific paper on the subject, to be read on March 7 before the Society of Chemical Industry. We shall content ourselves by presenting to our readers a short practical description of the process and its results.

Before doing so it will, however, be advantageous to give a short account of the method by which sodium has hitherto been separated from its compounds, in order that a clearer conception of the features in which the new process differs from the old one may be obtained. At high temperatures carbon has the property of separating sodium from its oxygen compounds, carbon uniting with the oxygen to form carbonic oxide, the sodium being thereby liberated. In the usual process this reaction is brought about by mixing carbonate of soda, lime, and carbon in small wrought iron cylinders, and exposing them to an intense heat, when a part of the sodium comes off as vapor. The lime is added to prevent fusion, for were the mass to melt, the carbon would float on the top, and could no longer attack the soda. The new process differs from the old principally in working with a fused mass of soda compound, this operation having been rendered feasible by the most ingenious device of weighting every particle of carbon with iron, so that the two chemicals—soda and carbon—are kept in perfect admixture, and are continually presenting fresh surfaces to each other as the liquid circulates in the crucible under the action of the heat. By this simple but beautiful plan of weighting the carbon, it is rendered possible to employ a soda compound which is decomposed at a much lower temperature than that hitherto used, and to carry on the process in large and durable vessels, instead of in small cylinders, which have a very short life. Having thus given a short account of the chemical process, we will describe the commercial method of manufacture.

The operations are carried on in large cast steel crucibles, and the charges consist of caustic soda and a finely ground artificial compound of carbon and iron, which is the reducing agent. This compound is made by coking a mixture of fine iron and pitch. The crucibles containing these materials are first heated in a small furnace at a low temperature, the object being to expel the hydrogen from the caustic alkali and bring about quiet fusion. The crucibles are then removed from this furnace, by means of a little truck, and placed upon a movable platform, which is operated by hydraulic power. They are then by this means raised into the large furnace, where the crucible covers are fixed stationary. The edges of the crucible and cover coming together form a tight joint, and from this cover projects a small tube to the outside of the furnace into a narrow rectangular box, known as the condenser. The reduction of the sodium commences soon after the crucible containing the charge is in its place, the vapors and gases passing from the fused mixture through the exit pipe from the cover into the condenser, where the metallic vapors are condensed to metal, while the uncondensed gases escape by a small outlet tube. After the charge is exhausted, the crucible is lowered, and one containing a fresh charge raised in its place; in this manner the process might almost be called continuous.

The actual temperature used in this process to bring about reduction, as measured by experts, has been found to be 850° Cent. By the older method the temperature necessary is about 1,400° Cent. This is practically the great point of economy in this process, as the high price of sodium has hitherto been owing to the excessive heat used in the older process and the consequent destruction of the wrought iron vessels. Sodium at present costs about four shillings per pound to produce, while the materials necessary for this quantity, were nothing wasted, would hardly cost four pence. The difference between these two figures represents the wear and tear to the furnace, the destruction of the wrought iron cylinders, the loss and waste of materials, the excessive labor and care necessary to employ in manufacturing, and fuel. Approximately, the cost of these items in producing one pound of sodium by the older process is as follows:

Two shillings is due to the destruction of wrought iron, etc.

One shilling is due to the loss and waste of materials, of which three times the theoretical quantity must be employed.

Eightpence is due to the labor.

Fourpence is due to the fuel.

Mr. Castner seems justified in his claim to produce sodium at a shilling per pound in large quantities. The steel crucibles which have now been in use some time show but little wear, and indicate indefinite use in future, thus reducing the first item of cost in the older process to a fraction. There is hardly any appreciable loss or waste of materials, and from four pennyworth of caustic soda is ultimately obtained one pound of sodium. The labor is a very small item of expense, and the fuel consumed is less than one-third that used in the older process.

Seventy-five tons of fuel are required by the older method in producing one ton of sodium. From actual results a like amount of fuel will produce over three tons of sodium by Mr. Castner's process. The results from this new process are not obtained by calculations on paper, as the inventor has shown from actual working that his claims are well founded. The process is no longer an experimental one, the furnace now erected having a capacity of 120 pounds of sodium per day, which is probably more than is produced at any works now in existence. The production of sodium at one shilling a pound by this process may be considered an accomplished fact, which ultimately means cheapened aluminum and a solution of the problem that has so long engaged the attention of chemists and metallurgists.

* The Cowles electric smelting process, heretofore described by us, has only produced aluminum alloys as yet, and it is doubtful whether it can be made to do more than this.

Preventive Medicine.

Dr. C. R. Illingworth thus writes in the *Med. Press:*

One of our great aims as physicians is to prevent disease; another is to cut short its course when developed. Our power in these directions finds full scope among that class of disorders now generally recognized as depending upon the reception, growth, and development in the tissues of micro-organic life in one shape or another. By the continual suppression of the growth and development of these forms of cell life, we may, indeed, hope at length to erase the names of the diseases they cause from the category of those "ills that flesh is heir to." The diseases I refer to are scarlet fever, diphtheria, measles, whooping cough, rheumatic fever, chicken-pox, small-pox, syphilis, hydrophobia, yellow fever, *et hoc genus omne.*

The germicide remedy I have found to answer as a specific and prophylactic in such diseases is the biniodide of mercury given in solution of potassic iodide. In all cases of scarlatina or measles occurring in one member of a family, I put the rest upon preventive medicine. Thus, for children I prescribe as follows: Bichloride of mercury solution, ℥ iss; iodide of potassium, ʒ j; ammonio-citrate of iron, ʒ j; sirup, ℥ iss; water to eight ounces. One or two teaspoonfuls to be given three times a day.

The Peace Army of the United States.

The following figures are believed to be approximately accurate, and most interesting and instructive they are:

French army, peace footing	523,283
German army, peace footing	445,417
United States army of pensioners, peace footing	400,000

One of the great evils of a huge standing army is the cost of its support—a constant drain upon the national resources.

It does not seem that in this respect we have so very much the advantage of France or Germany, loaded down as those nations are with military burdens.

The great difference is that, while all or nearly all of the French and German soldiers, supported at the national expense, are available in case of a national emergency, few or none of ours are.

Is this enormous burden a just debt?

The question is best answered by another question. Is it not fair to assume that in 1877, twelve years after the end of the civil war, about all the equitable claims for pensions on account of that war had been put in and allowed?

Yet since 1877, the number of pensioners on our rolls has almost doubled; and the annual cost of maintaining them has nearly trebled.—*N. Y. Sun.*

A Solid Life Insurance Company.

The figures of the last annual report of the New York Life Insurance Company, just issued, present a record of almost unexampled success in the conduct of the business of that old and strong company for the past year. Its income for the year was $19,230,408, it paid policy holders $7,627,230, and it has cash assets amounting to $75,421,453. It goes without the saying that this great company does its insurance business on strictly business principles. It recognizes the policy holder's right to paid-up insurance in case of a discontinuance of payment of premiums, and its policies are notably free from restrictions as to occupation, residence, and travel. The company issues a great variety of policies, thus adapting its contracts to the wants of almost every one having present means from which a small percentage can be spared for the benefit of themselves or those dependent upon them at a future date.

DR. GILES DE LA TOURETTE has recently published a monograph upon normal locomotion and the variations in the gait caused by diseases of the nervous system. He found, from a comparsion of a large number of cases, that the average length of pace is, for men, 25 inches; for women, 20 inches. The step with the right foot is somewhat longer than that with the left. The feet are separated laterally in walking about 4½ inches in men and about 5 inches in women.

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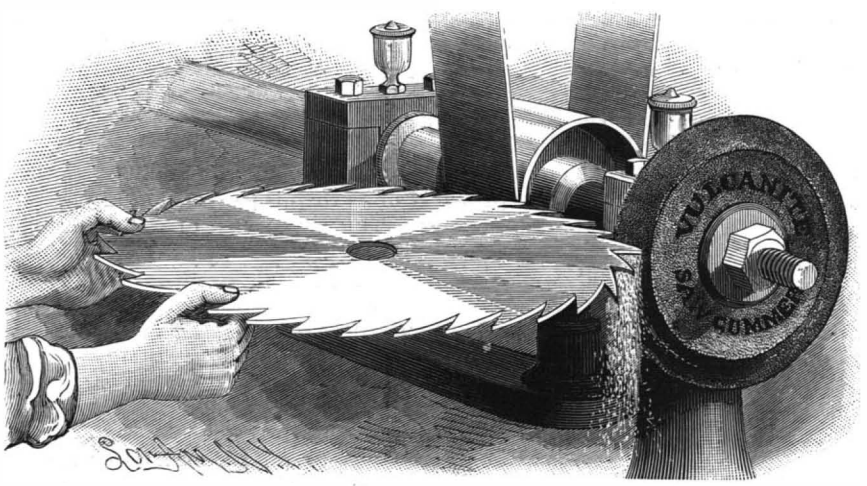
EMERY WHEELS FOR GUMMING SAWS.

In the illustration herewith, the operation of gumming saws with an emery wheel is vividly represented, the frame affording sufficient support for the side of the saw where the teeth are being ground, and the arrangement being a simple one, readily made at any work bench or machine where a shaft is run upon which an emery wheel can be placed. The operation itself involves only the simplest mechanical knowledge and but a rudimentary experience in the handling of tools, yet the desirability of this method of sharpening saws is largely dependent upon the kind of emery wheel used and the rate of speed at which it is run.



EMERY VULCANITE SAW GUMMER.

The vulcanite emery wheels made by the New York Belting and Packing Company have especial advantages for this kind of work. They are strong and safe at the highest speed at which it is desirable to run them, the company recommending that they never be run at a less rate than 6,000 feet per minute circumferential speed, and from that up to 8,000 and 10,000 feet per minute, although the lowest named speed is rather above the ordinary limit of many other kinds of emery wheels, and attempts to run other wheels at or beyond this limit have frequently resulted in serious accidents, from the breaking of the wheels. The higher rate of speed, which not only cuts faster, but, in the case of the vulcanite emery wheel, prolongs the life of the wheel, is concededly safe with the vulcanite wheel. Thus run, it is not likely to wear out of true, the operator does not have to bear on so hard, and the wheel retains its shape much better than when run at a slow speed. The nature of the wear of the working surface in the vulcanite wheel is claimed to be essentially different from that in wheels where the emery is fixed in its place by other methods, the rubber affording an elastic foundation or cushion, from which the particles of emery slightly protrude. This not only insures more efficient work from the cutting edges of the emery, as they become changed by use, but allows of more access of air to the work, thus tending to prevent casehardening of the edges of the metal being ground.

In addition to wheels with bevel shaped grinding surfaces, as represented in the engraving, the company also make wheels with round grinding surfaces, and this kind is always considered best for large saws.

THE FRILLED SHARK—THE OLDEST LIVING TYPE OF VERTEBRATES.

In technical terms this is a living species of ceadodont shark, named by Mr. Garman *Chlamydoselachus anquincus*.

The specimen here figured was found in a miscellaneous collection of fishes, etc., in alcohol, furnished the Museum of Comparative Zoology by Professor H. A. Ward, who purchased them in Japan. It was soon recognized as not only belonging to a new family, but one closely allied to certain forms supposed to have become extinct in the Carboniferous time. This discovery displaces *Ceratodus* from the position of the oldest living type of the vertebrata.

The term Chlamydoselachus is applied on account of the curious frill-like mantle that surmounts the first gill cover. The term is made up of two Greek words implying mantle and shark. Six gill openings, and certain structure of the brain, remove this form from the present known sharks. Its affinity to some of the earliest known sharks, those of the middle Devonian, render it of great interest and importance to science. The family characters which this form represents, under the term *Chlamydoselachidæ*, are: Body elongate, with a depressed head. The eyes are lateral, with no nictitating membrane. The nasal cavity is separate from that of the mouth. The mouth is situated anteriorly, like that of some fishes. The teeth have broad, backward extended bases and slender cusps. The spiracles are present. One dorsal fin, spineless, is present. There is also an anal fin, and a caudal with no pit at its root. The first gill cover is free across the isthmus. The intestine has a spiral valve.

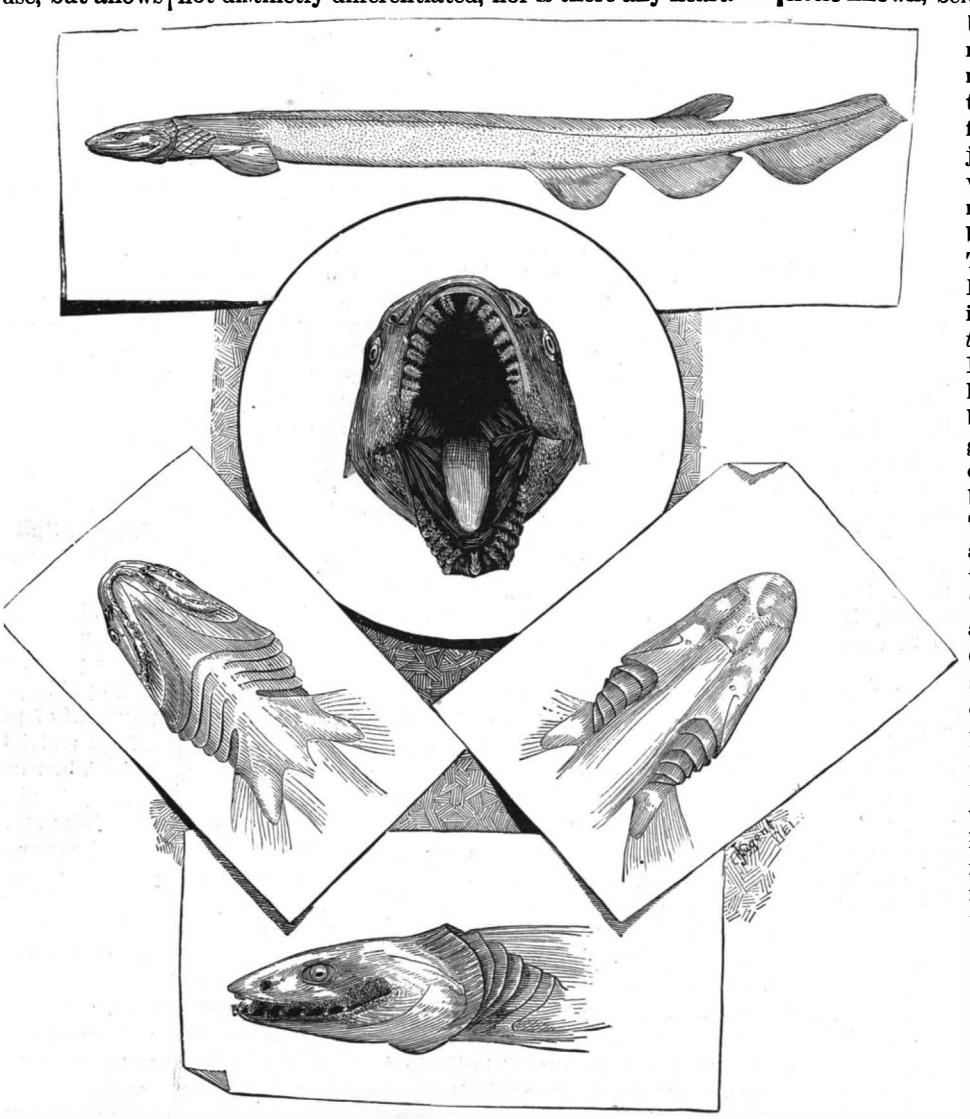
The generic characters are: Six gill openings, opercular flap, first gill cover, broad. Teeth similar in both jaws; each with three slender, curved, subconical cusps, separated by a pair of rudimentary denticles or a broad base. There is no median upper series of teeth in front, but there is a series below, on the symphysis. The mouth is wide, and has no labial folds at the angles. The pupil is horizontally elongate; the fins are broad, the caudal without a notch.

The total length of this shark is nearly five feet. Its greatest width, across the ventrals, is seven inches. Its resemblance to a snake is very striking. Its elongated body, long, flattened head, anterior mouth, and sinister expression of the eyes are quite suggestive of the ophidians. There are fifty-one rows of teeth, and six teeth in each row; the whole number at one time in function is 306. The brain is very small.

The present state of icthyological science recognizes eliminations that have been made from its main body. Comprehensively, a fish is a cold-blooded vertebrate, adapted for life in the water, breathing by means of gills, having the limbs, if present, in the form of fins, the smaller members being represented by cartilaginous rays connected by membrane. One or more fins are developed on the median line of the body.

The lancelets, myzonts, myxinoids, hag fishes, lampreys, sharks, and rays are recognized as differing sufficiently from the true fishes to entitle them to places of class distinction.

The true fishes form one class; the elasmobranchs, sharks, and rays, another class; the marsipobranchs, myxinoid fishes, hag fishes, and lampreys, a class; and the lancelets and cirrostomes, a class. It will be seen, then, that technically there are four classes of fish-like vertebrates, where but one—fishes—has heretofore been recognized. The lancelets, as is well known, are the lowest in the scale, their structure being extremely simple. The skull in this class is undeveloped, the brain not distinctly differentiated, nor is there any heart.



THE FRILLED SHARK—THE OLDEST LIVING TYPE OF VERTEBRATES.

The term Leptocardii, which designates this class, means thin heart, in reference to the simplicity of this portion of the arterial system.

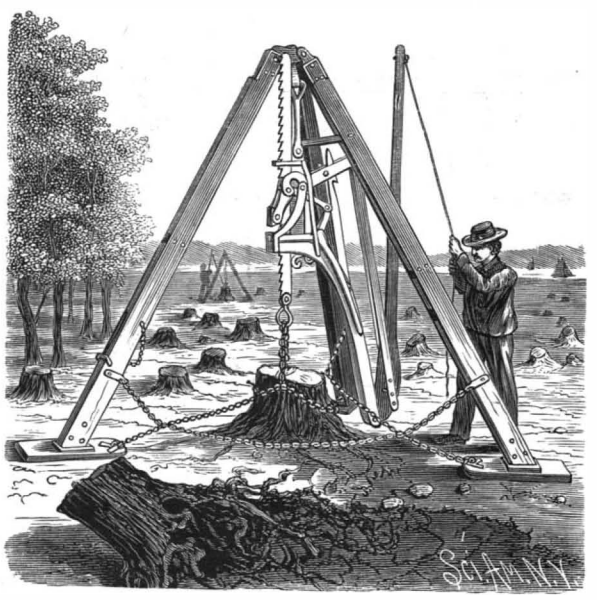
At first sight of the mouth of the frilled shark, which is figured here, the teeth have a singular and wholly unnatural appearance, appearing like indented, leaf-like organs; but it is seen that there are three fangs, serpent-like, on a base, and several rows of them give the peculiar appearance, arranged as they are consecutively from before inward.

The Port Jackson sharks, of the family *Heterodontidæ*, have long been regarded as of great interest to paleontologists, from their being closely related to some extinct sharks. Under the term Cestracion (now *Gyropleurodus*), these sharks are known to naturalists. A species, *G. francisci*, is now found off the coast of California.

Cestracion phillipi is found in the Australian seas. The term cestracion is from the Greek *kestra*, a weapon. Many of the extinct species are known by the preservation of this spine, which being of more durable structure is preserved after all other traces of the creature have passed away.

The mouth of the frilled shark, as seen in our engraving, is peculiar appearing for a shark, as this important part is usually situated far beneath. In this respect, the anterior aspect of the mouth, there is resemblance to that of the great rhinodon, the largest living fish, measuring 70 feet in length. The general appearance of this shark is, however, extremely different from that of the frilled shark. The rhinodon is immensely bulky, the head being quite as deep and wide as any other portion. A very interesting structure, and one little known, belonging to the latter is a set of whalebone-like fringes along the gills, arranged comb-like. These frills have much the same functions of those in the whalebone or right whales. The food of the creature is mostly of sea jellies and other soft pelagic animals, which are strained into the throat by means of this adaptation. The great basking shark has this structure. This shark has been taken off Block Island measuring, according to authority, nearly seventy feet. It is the *Cetorhinus*, or bone shark, also so called. Large as these creatures are, they are harmless, most fortunately, their teeth being very small. Their food being of gelatinous animal matter, the masticating apparatus is not required to be of any considerable size or strength. The more harmful sharks are of moderate dimensions, in which the teeth are very large. In the largest species of "maneater" shark living, the teeth are about two inches in length. Some of the great carcharodon-like fossil sharks have teeth measuring five inches and a half in length. One in my possession has that measurement. Judging from the size of the shark, which has a tooth two inches in length, the extinct species here indicated must have been much over one hundred feet in length. Such enormous size can more readily be accommodated in the vast ocean than that of the great land beasts on their appropriate element. I am indebted to papers on this subject by Mr. Garman, of Cambridge, Mass., for material of this account.

J. B. H.



TICHENOR & WALKER'S IMPROVED STUMP PULLER.

[FOR DESCRIPTION SEE PAGE 132.]

IMMEDIATELY after eating, a person weighs more than before it.

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COMBINED BENCH AND IRONING BOARD.

The bench is composed of side pieces, legs, end pieces, and a central cross brace. At one end it is provided with stationary top pieces having curved inner edges, as shown in the upper view, which are covered with a thin strip of angle iron extending up flush with the top and bent to conform with the curved edge.

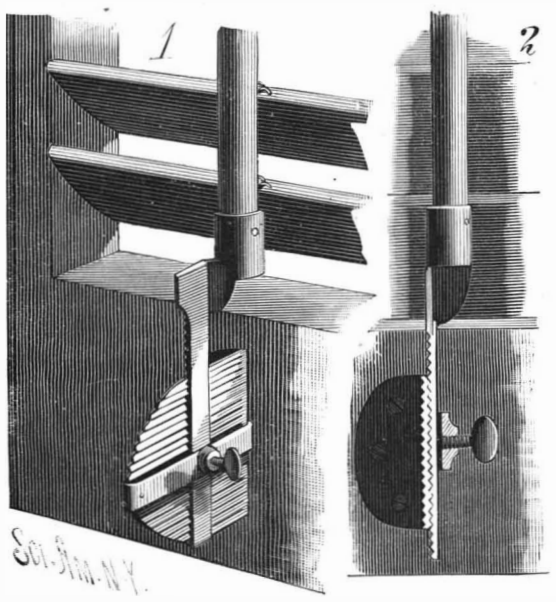
WELLER'S COMBINED BENCH AND IRONING BOARD.

To the upper ends of the legs are hinged supports adapted to extend upward to form continuations of the legs, to engage with and hold an ironing board in a horizontal position. A tongue formed upon the free end of each support enters a socket box fitted in a recess formed in the board, so that the hinged lids of the boxes are flush with the bench surface of the board. When the board is in position to be ironed upon, the hinged lids rest against the sides of the supports, an opening in the lids receiving pins projecting from the sides of the supports. The lids are held in this position by suitably arranged buttons. By this means the ironing board is securely fixed in its elevated position. The rigidity of each support is promoted by another button attached to its inner side, and which enters a slot in the top edge of the side piece. To convert the ironing board into a bench, the board is lifted up and the supports closed down within the bench, as shown in the lower view. The wraps used upon the board are then placed neatly over the supports. The board itself is then turned over and its narrow end slid under the projection of the angle iron to a bearing upon the upper edges of the bench frame. The board now forms a smooth top for the bench. The under side of the ironing board, when forming a seat, is recessed near each side of its square end. Each recess is covered by a metal plate having a diamond-shaped opening to receive the elongated head of a bolt secured to the inner face of the bench side pieces. The square end of the board is thus held to the bench, the narrow end being held by the angle irons.

This invention has been patented by Mr. Daniel H. Weller, of Boyertown, Pa.

IMPROVED BLIND STOP.

By means of the simple attachment here shown, the blind may be securely held in any desired position. Secured to the lower cross bar is a metal plate, bent at



GULICK'S IMPROVED BLIND STOP.

right angles to form flanges, the projecting one of which is finely corrugated. The plate is held to the bar by screws passing through the other flange. Across the face of the outer flange is secured a spring retaining strip, which bears against the corrugated face and which carries a set screw. To the end of the slat bar is secured a corrugated strip, which is passed between the flange and its strip, the corrugated faces resting against each other, as shown in the right hand view.

This device will hold the slats in any required position, but when the slat bar is subjected to a positive pull, the strip will slip upon the face of the flange, against which it will be held by the action of the spring strip. By means of the set screw, the parts may be so locked together as to prevent the turning of the slats from the outside.

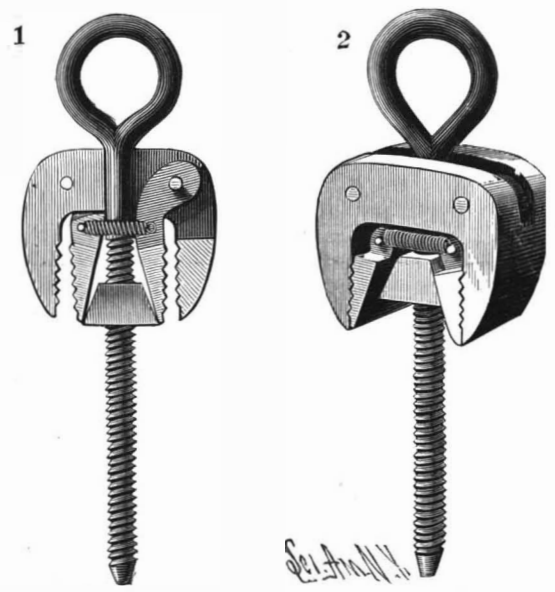
This invention has been patented by Mrs. Lizzie T. Gulick, of Corsicana, Texas.

The British Armament at Victoria.

Some mistake appears to have been made in the recent announcement that the British Government are sending out a number of eighty ton guns for the coast defense of Esquimault and Victoria. Twelve sixty-four pounders have been sent out from England, not for the armaments of the forts, but to be placed on board the British ships of war belonging to the Pacific squadron or to go into the naval reserves. Some time ago the British Minister of War made application to the Canadian Pacific Railway to know if they could transport one or more eighty ton guns over their road. An estimate of the cost was given, with the model of a car composed of three trucks, which it was proposed to use if the shipment was made. Since then nothing has been heard of the eighty ton guns. The officer in command of the British Columbia district does not speak very creditably of the condition of the armament at that point. The artillery armament is described as old, the carriages and limbers are reported rotten and are falling to pieces, while the guns are without sights. The batteries at Victoria and Esquimault, the officers say, are in a discreditable condition.—*N. Y. Evening Post.*

A SIMPLE DEVICE FOR CRIMPING BOOTS OR SHOES.

The crimper herewith illustrated has a yoke-shaped stationary portion, the jaws of which are formed with



LA FOLLETTE'S BOOT CRIMPER.

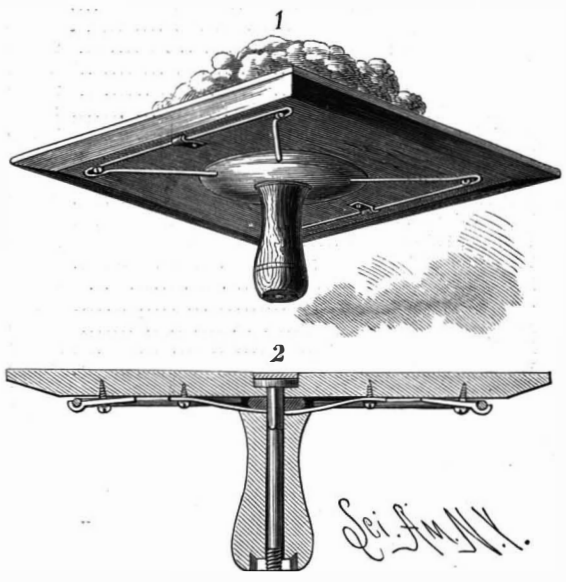
transverse corrugations. The top of this yoke has a longitudinal slot, in which are pivoted the upper reduced ends of movable inner jaws, whose operative faces have transverse corrugations, arranged to always meet and fit within the corresponding corrugations of the outer jaws. These inner jaws are normally held open by a spring. The operating or crimping screw slides freely through the slot in the yoke, extending between the inner jaws, and on its lower portion fits a wedge-shaped clamping block, which is drawn up between the inner jaws by turning the operating screw. The outer end of this screw being placed in an aperture in the heel of the last, or in other suitable position relative to a form over which the leather is to be crimped, and the edges of the leather placed between the jaws, the leather may be strained about its forming block as desired by simply rotating the screw.

This invention has been patented by Mr. Elery B. La Follette, of Flemington, West Va.

PLASTERER'S HAWK.

The object of this invention, which has been patented by Mr. Geo. W. Jaques, of Burton, O., is to provide a plasterer's hawk in which the board on which the mortar is received, and which is subjected to expansion and contraction due to alternate moistening and drying, may be rendered light and rigid and, at the same time, be free to expand and contract without warping or cracking. In the center of the board is secured a bolt, upon which is received a handle having a nut in its outer end fitting the end of the bolt. A circular concave plate is placed on the bolt, between the handle and board, with its concave side toward the board. Between the plate and board is held an elastic rubber washer, which is compressed by screwing the handle down.

The plate has a plane edge, which is secured to the board by screws, and in the edge are four notches for receiving the ends of wire frames that extend a short distance under the plate, by which they are clamped to the board. Each frame consists of a wire, bent to the shape shown in the upper view in the engraving. Through the end loops are passed screws, projecting from the board, and the center of each frame is secured to the board by a clip, the clips and bolt being ar-

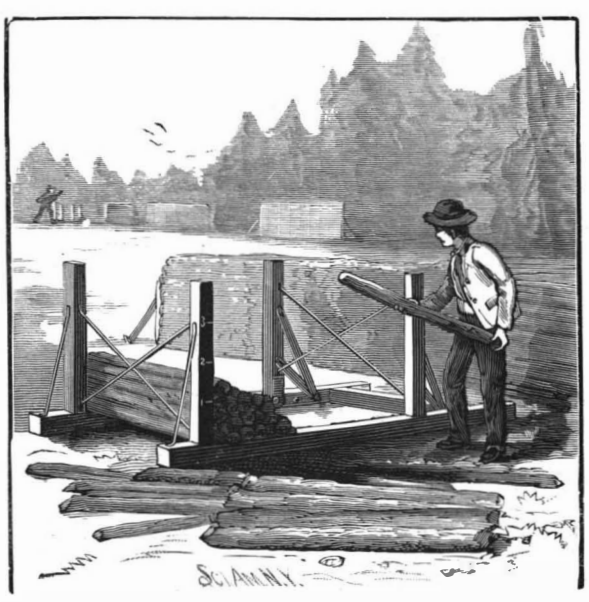


JAQUES' PLASTERER'S HAWK.

ranged in a line parallel with the grain of the wood. The frames support the edges of the board, and the loops permit of the lateral movement of their screws and the portions of the board by which they are carried. This hawk weighs, even when thoroughly soaked, only one pound and a half, the old style weighing from three to five pounds.

ADJUSTABLE WOOD MEASURING RACK.

By means of this device wood may be measured by the cord or fractional parts of a cord, as occasion may require. The sill frame consists of two longitudinally ranging timbers connected by cross bars. Near one end of the timbers are fixed uprights, braced to each other and to the timbers. To the inner faces of the sills are screwed a series of headed pins, the first one being exactly one foot from the inner face of the end posts, and the others being spaced one foot apart. Two posts, braced together by rods, are adapted to stand on the sills, and to the inside face of each post is attached, by coach screws, a metal plate provided with a hook at its lower end, adapted to engage with the shank of one of the headed screw pins of the sills. Attached to each post is a brace with two arms, and formed at its lower end with a notch to engage the pins on the sills. The metal plates and braces are slotted for the passage of the screws, so that the movable frame may be quickly and easily set perfectly plumb, whichever opposite pair of the sill pins may be engaged by the hooked plates. The posts are exactly four feet high, and one is marked by cross lines one foot apart. It is apparent that, to measure a cord, the frame is moved to the eighth set of pins and the wood is piled to the tops of the posts. To measure half a cord, the hooks are engaged with the fourth pins. By adjusting the hooks to the first pair of pins, and filling the wood in between the end posts up to the first cross line on the post, a single foot of wood can be measured, or up to the second line for two feet, and so on. Thus a cord or any fractional part



BROUGHTON'S ADJUSTABLE WOOD MEASURING RACK.

can be readily measured. To disengage the frame, it is only necessary to tilt it forward toward the fixed posts, when it may be shifted to any point along the sill frame.

This invention has been patented by Mr. Horace L. Broughton, whose address is P. O. box 320, Marblehead, Mass.

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Steel Rail Capacity of the United States.

Name.	Capacity in Tons.
Springfield Iron Company	12,000
Indianapolis Rolling Mill Company	75,000
Joliet Steel Company	200,000
Lackawanna Coal and Iron Company	216,000
Troy Steel and Iron Company	120,000
Montour Iron and Steel Company	90,000
California Mills	50,000
Lochiel Iron and Steel Works	65,000
Cleveland Rolling Mill Company	200,000
Roane Iron Company	50,000
Union Steel Works, Chicago	168,000
Colorado Coal and Iron Company	125,000
Cambria Works	100,000
Western Steel Company	132,000
South Chicago Plant	250,000
Bay View Plant	50,000
North Chicago Plant	200,000
Carnegie, Phipps & Co	125,000
Union Iron Mills, Pittsburg	50,000
Edgar Thomson Plant	450,000
Cranston Steel Company	175,000
Pennsylvania Steel Company	300,000
Bethlehem Iron Company	250,000
Worcester Steel Works	50,000
Total apparent rail capacity	3,671,000

PENBERTHY INJECTOR.

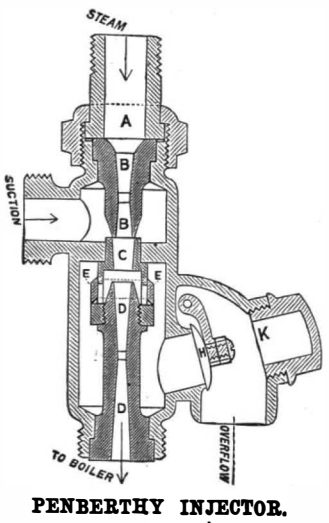
At last a mechanical combination and device has been produced, and a man's labor and study crowned with success, in the production, for the convenience of engineers, of a simple and compact device known as the Penberthy injector or boiler feeder.

Its mechanical construction is very simple, but perfect. All its parts are movable and convenient of access (not being screwed in), its working so complete that an inexperienced person can operate it with success and perfectness. Its adaptability to all classes of boilers, such as stationary, portable, traction, marine, and locomotive, and its working on each, makes it very desirable, and recommends it to all classes of engineers. The automatic working of this injector is of very great advantage, as by this mechanical construction it works under all conditions of shakes, jars, and concussions. In case of a break, or the suction is to be removed and then returned, it picks up or begins working without any aid, assistance, or attention from the engineer, thereby relieving of much care and annoyance. Its convenience of access is of very great consideration and importance, owing to the advantage of cleaning and examining its interior parts.

The working parts of this injector are stationary in their work, thereby causing comparatively no wear in its mechanical parts. The inventor seems to have combined common sense with mechanical science, by leaving out all complications, and combining in the injector every convenience of operating, getting at, and putting it on the boiler.

The body is of a single cylinder or barrel, with two jets inside, "steam and combining," and governed by an automatic swinging overflow. The injector is operated by the opening or closing of the globe valves. It is connected to the boiler and pipes with uniform and interchangeable square centered unions, and can be put on or taken off very quickly without any annoyance or injury, and the only tool required being an ordinary wrench.

Another great point gained in this injector is its great range of working capacity. It will lift water twenty-five feet perpendicular, or take it a hydraulic pressure and force it into the boiler at a temperature of from 140° to 180° Fah. It will work under a steam pressure of from 20 to 140 lb. It will also lift and force water



PENBERTHY INJECTOR.

at a very warm temperature (say 120° Fah.) in tank or well, and under all circumstances and at all points it works automatically. The inventor and manufacturers of the Penberthy injector have great confidence in its working qualities, and to satisfy engineers of its merits and perfectness of work, solicit a trial. From observation, a brilliant future is in store for this little wonder of simplicity and compactness, which is a model of mechanism in appearance and finish.

For prices, etc., address Jenkins Bros., 71 John St., New York, 13 So. 4th St., Philadelphia, and 105 Milk St., Boston, agents for this injector.

PROTECTOR FOR LADIES' HATS.

This simple and readily adjustable protector may be quickly applied to and removed from a hat or bonnet, without injuring its delicate trimmings, and may be adjusted to fit large or small hats. The main portion of the protector, which alone will be used to cover hats of small or medium size, consists of a piece of some light waterproof fabric strengthened about the margin with an inside facing. At the inner face of the body are secured a couple of narrow strips of suitable fabric (Fig. 2), forming casings for drawing strings. At the opposite edges of the facing are attached small rings, through either series of which a drawing string may be passed.

The extension piece (Fig. 1) of the protector consists of an endless band of waterproof fabric, like that of

HOPKIRK'S PROTECTOR FOR LADIES' HATS.

the body, provided at its edges with bindings, to which rings for drawing strings are secured. The protector can readily be adjusted and held upon a small or medium sized hat by properly manipulating the drawing strings. To adapt the protector to a large hat, the extension piece is united to the main piece by a string passed through the inner series of rings on the facing and through one of the series of rings on the extension piece. A string is then passed through the other rings of the extension piece, when the protector can be held to the hat by adjusting the drawing strings. It is evident that this protector may be applied over a hat without danger of crushing the most delicate trimmings.

This invention has been patented by Mrs. W. H. Hopkirk, of Agency, Iowa.

IMPROVED STUMP PULLER.

The stump puller shown in the accompanying engraving (page 130) is exceedingly powerful, as, by a system of compound levers, a pull of one pound on the operating bar will exert a pull of 384 pounds on the stump, and if the lifting chain be passed around a single pulley, this power is doubled. With one of these machines one man has pulled a green maple stump two feet in diameter from clay soil. The pulling mechanism is supported by a tripod, to the upper end of which is secured a chain carrying a bar or plate provided with a bearing in which slides a notched bar. Meshing with the notches of this bar are the teeth of a pawl, which is so connected, by levers, with the operating handle that the downward movement of the latter will raise the pawl and notched bar and the chain attached to its lower end. A sliding bolt then holds the notched bar in its raised position, when the handle can be raised to enable the pawl to engage with the next lower teeth of the bar. Thus, by a succession of up and down movements of the handle, the notched bar may be elevated its entire length, or until the stump is pulled completely out. It will be seen that the sliding bolt permits of the upward, but prevents the downward, movement of the notched bar when the pawl is disengaged and slides downward. But, by means of a suitably arranged hand lever, the pawl may be moved so as to be out of contact with the bar, and, at the same time, the bolt, which is pressed forward by a spring, may be moved to disengage it from the notch in the bar, which may then be adjusted in any desired position. The machine is built of steel and malleable iron.

This invention has been patented by Messrs. R. R. Tichenor and P. Walker, of Henning, Minn.

The Defense of New York within Thirty Days' Time.

The idea seems to prevail that the United States is absolutely helpless against a naval attack from England. I think this idea is entirely erroneous. There is the pneumatic gun, capable now of throwing 300 lb. of nitro-glycerine, which amount could easily be increased to 1,000 lb. For the value of one modern ironclad, 150 steamers with such a gun could be put in service in two weeks by the United States, because any steamer of 100 feet or over would answer; while the gun, being a mere tube, subjected to but 1,000 lb. of air per square inch, with air-compressing machinery, is all so available and quickly built that a month would put the United States into possession of 500 of them. If, now, 20 such steamers be told off for each ironclad sent against us, even if two-thirds were sunk, they would, before being entirely demolished, succeed in depositing 5 to 10 tons of nitro-glycerine on the deck of the ironclad, and exploding it.

Would not the effect of repeated explosions of 1,000 lb. of nitro-glycerine blow the deck in, dismount the guns and engine, and shake the armor loose, as the explosions of the Monitors' guns did when they were in service in the late war—the heads of bolts and other fastenings of the armor flying off from the concussion.

Then there is the submarine boat, that has already stayed under water thirty minutes with its crew, and been easily and correctly guided. What is in the way of using ten such boats to each ironclad, one of which would unquestionably succeed in placing 1,000 lb. of nitro-glycerine under the ironclad, the explosion of which would be heard from? Because the explosion of 90 lb. of gun-cotton did not materially damage an ironclad, can it be reasoned that 1,000 lb. of nitro-glycerine, which would have twenty-five times the force of 90 lb. of gun-cotton, would be equally ineffective? Hardly, I think.

Nets, etc., would not prevent such boats from diving under them, while they would only impede the speed and maneuvering of the ironclad, and render her more easily approached.

Blucher, the German cavalry officer, insisted that it was the impression and belief existing in Germany that Napoleon was invincible, and the Germans helpless, that alone prevented them from conquering. When the occasion came when he could demonstrate this, the Germans and allies easily defeated and dethroned Napoleon.

It is similarly true in this country, for too many believe that the English ironclad is invincible, and this impression makes cowards of too many. Give the nitro-glycerine gun and submarine boat a trial, if occasion arises, and England's ironclads will succumb as easily as Napoleon when sufficient power of the right kind was brought to bear on him. The right kind of power to apply to England is nitro-glycerine and dynamite, which could be ready with guns and boats in a month or less. One hundred days sufficed to build the first Monitor many years ago, and much less time will be needed for dynamite guns. WAYNE.

Electroplating with Platinum.

Platinum has not been much used in electroplating, notwithstanding its hard, durable, and protective properties. This is, perhaps, chiefly owing to the practical difficulty of obtaining a good firm "reguline" deposit. A process for effecting this has, however, been brought out recently by a Mr. Bright, whose patents have been acquired by the Bright Platinum Plating Company, and are in actual operation in London at works established there. Platinum has the advantage of keeping its color where silver, brass, or copper becomes discolored, and will, to some extent at least, replace the use of these metals in electrotyping. It will be highly useful in plating chemists' crucibles and so on. German silver, for example, plated with platinum can be used to manipulate strong acids. By the Bright process, platinum can be deposited on any surface which can be electroplated with other metals.

COMBINED BRUSH AND COMB CLEANER.

The invention herewith illustrated relates to a device for cleaning brushes and combs. It consists of a handle or body of suitable form, provided at one end with a brush, and at the opposite end with thin curved fingers of metal, or equivalent elastic material, adapted to enter between the teeth of the comb or the

BROOKBANK'S COMBINED BRUSH AND COMB CLEANER.

bristles of the brush. In making use of the device the hooks are employed to loosen and remove, as far as possible, the hairs or other foreign matter, after which the brush is employed to complete the operation. It is intended to afford a cheap, simple, and efficient means of cleaning articles in daily use in every household, and is virtually sure, considering the low cost at which it can be manufactured, to become a staple article of merchandise. The invention has been patented by Mr. J. O. Brookbank, of Driftwood, Cameron County, Pa., to whom all particulars relating to purchase of rights for the United States and Canada should be addressed.

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Correspondence.

Coincidence of Charleston Earthquake with a Reported Eruption in the Tonga Group.

To the Editor of the Scientific American:

I would like to call your attention to a reported coincidence, described in a letter in the London *Times* of December last. An interview with captain and crew of a vessel just then arrived at Sydney, Australia, from Tonga Islands, is given. The captain is represented assaying that while lying off the islands on the night of the 31st of August, 1886, he observed a most terrific eruption of a volcano situated on one of them, accompanied by earthquake shocks, and the vessel received showers of dust and ashes. The occurrence on the same night with the Charleston earthquake on this continent is curious, to say the least. The statement might be acceptable to those of your readers interested in seismic disturbances.

P. MAX. FOSHAY.

Beaver Falls, Pa., February 2, 1887.

Incendiary Birds.

To the Editor of the Scientific American:

I write to relate an incident which may be of interest to some of the readers of your valuable paper. There is a bar iron mill, situated in a neighboring town four miles from here, that has been on fire three or four times, in which the English sparrow might be called the incendiary. These sparrows pick up old pieces of cotton waste, which they build in their nests, among the timbers of the roof of the mill, and in every case of the fires above mentioned, these nests were the cause, either from spontaneous combustion or from sparks from the hot iron striking and lodging in the nest. If you could suggest some way of getting rid of the sparrows, I think the manager of the mill would be glad to adopt your plan. R. W. KEAR.

Pottsville, Pa., February 14, 1887.

Charcoal as Fossil.

To the Editor of the Scientific American:

Perhaps charcoal has not often been observed as occurring naturally with mineral coal, though, as a result of metamorphism, graphite is not uncommon in coal districts.

In a variety of bituminous coal that comes from Tennessee, and that is largely used in this State, there are to be seen along in the cleavage planes films of true charcoal, in varying quantity, but commonly thin. This coal has been coming to us for several years, and all the while I have noticed in it the presence of the charcoal. I have scarcely ever put coal into the fire without making the observation; and there is perhaps not a lump, of size at all considerable, that does not contain these films.

On close examination, I have frequently found that the surface of the films on the broken lumps contains a delicate tracery, closely resembling vegetable impressions. The tracery is not so well marked as a fossil imprint, but not so indistinct as to escape notice.

J. F. B.

Emory College, Ga.

Phosphorescent Birds.

To the Editor of the Scientific American:

In reading of the habits of the wading birds, and particularly of the crane, I do not find that naturalists give any account of their manner of attracting their prey at night. My attention was called to the matter while gigging for fish, by frequently observing dim phosphoric lights appear and disappear along the shore like jack o' lanterns, which I for a long time supposed them to be. On one occasion I fired at such a light, and brought down a large blue crane, on which the phosphoric spots were clearly visible after death. There are two such spots; the larger being high up on the breast and the smaller at the bottom of the breast bone, the bird having power to reveal and conceal them at will. I have since stuffed many of the water walkers, and find that all have the same general arrangement of the feathers, and, as I believe, the same power of lighting up the water to attract the fish. Will some naturalist who is posted on this subject please throw some further light upon it, for the benefit of science? ISAAC N. WORRALL.

Topeka, Kansas.

Canned Fish, Meats, etc.

A correspondent in British Columbia, who is engaged in the business, gives us the following practical information:

Noticing your reply to a correspondent anent canned goods, I recently opened several cans of salmon that were processed in July of 1879, 1880, 1881, and on comparing them with last season's cans, found it impossible to detect the slightest difference. I hold that if a can is once perfectly sealed, the contents will remain unaltered as long as the metal casing remains intact.

A can will keep if every portion of the contents has been subjected to a temperature of 212° Fah., whether the air is expelled or not, as my experiments have conclusively proved.

When I first began the business, I was taught that the air unless expelled would cause the contents to deteriorate, and that was the reason the cans were vented. I soon found it was a mistake. The venting is done for the purpose of testing for leaks. A tight can has a sound that cannot be mistaken for a leaky one. If your correspondent boils his fish, flesh, or fowl with the vents open, he will have dry cans for his pains. The vents must be closed when cooking, and opened, in the case of meats, after boiling one hour, then closed and returned to kettle, and boil three hours for fish and less for meat without bone. Fruit is vented and closed when finished. S. H.

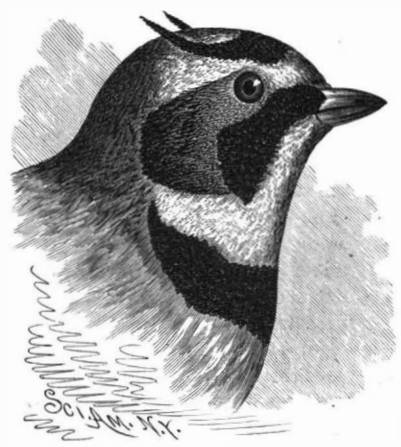
OUR WINTER BIRDS.

BY E. M. HASBROUCK.

It is a popular belief that the woods and fields in winter time are void of bird life, and are what they appear at a distance—a cold, bleak, and desolate waste.

This opinion, however, is not correct. It is true that the birds, which were so numerous during the summer, have left us and gone to their winter homes, but as they departed an entirely different fauna started from a colder climate, and gradually took their place. I refer to the birds of the northern part of Canada and the fur countries, whose summer homes are in these desolate regions, and which on the approach of winter are driven southward, making a temporary stay with us until the rigors of an Arctic winter shall have departed, and once more left their homes in an inhabitable condition.

A glance at these birds will take one into the same localities that have been so often traversed in the summer time, and once within the woods, the fact that they are cold and leafless is lost sight of. One can now find birds entirely different from any that he has heretofore seen, and at the same time learn several facts of interest concerning birds with which he considers himself well acquainted; as, for instance, the American goldfinch, which is supposed to migrate in the fall, will be found in the swampy woods in large flocks, but with plumage so changed that they will probably not be recognized, being of a somber brown color, and sexes undistinguishable. Why hundreds of a species, the majority of which migrate regularly, and which do not reach us until late in the spring, should change their dress and remain with us throughout our most severe winters is a problem.



In company with them will often be found the pine linnet and common red poll. These little finches are rather rare, and are seldom found together in any great numbers. They leave the North in large flocks, but as they journey southward break up into smaller and smaller companies, until only a few are left together. These join interests with the nearest goldfinches, and remain with them throughout the winter.

The results of a visit to the fields, on some clear day, will often repay a somewhat wearisome tramp. The snow buntings and shore larks frequent such places in large numbers, and a locality where the ground has been swept bare of snow, or is covered with a growth of weeds, is a favorite feeding ground.

Their food consists entirely of the seeds, and a spot once chosen by them is seldom forsaken until all in this line has been eaten.

The buntings will be found in flocks of from a dozen to two hundred, and in some even more. Their appearance when flying is pure white, but the upper parts of a specimen in the hand will be found mostly black. They are extremely shy, and when approached spring into the air and dart away in a manner that would indicate their intention of departing for the next county; but should you return that way in the course of half an hour, you will, in all probability, find them in the same place.

The shore larks, although feeding on the same grounds, seldom mix with the buntings, preferring to keep in flocks by themselves, and are worthy of attention, inasmuch as they have one marked peculiarity; this is the small tuft of feathers on each side of the head, resembling minute horns, which are raised and lowered at pleasure. (See cut.)

The majority of these birds reach us at the approach of cold weather, although a few spend the summer here and rear their young. They are less timid than the snow bunting, and may often be approached quite close.

These two species form about all the attraction to be found to any extent in the fields, and, aside from an occasional hawk, only one more species frequents them, a species that is worth going miles to see—the snowy owl.

These birds reach us about the last of November and remain until the last of February, frequenting the neighborhood of some body of water, and seldom straying from it more than a mile or two. To see them and become at all acquainted with their habits, one must face all kinds of weather, possess untiring energy, and must undergo a considerable amount of fatigue. He will find them in the open country (as they frequent such ground altogether, seldom, if ever, entering the woods), perched on some fence post or stump, where, if undisturbed, they will remain for a considerable length of time, intently watching for mice, of which their food largely consists, set off by an occasional rabbit. They are extremely rare. One may tramp the fields for several days without success, and then again find one the first hour out.

On December 20, 1886, the writer started on a trip to Oneida Lake, N. Y., intending to devote his attention entirely to these birds; was gone four days, and saw five birds. This, of course, was exceptional, but shows what may happen.

In the dense pine and hemlock swamps several other species of owls are found, which are much more numerous at this season than in the summer. These are the long eared and short eared owls, with an occasional barred owl; but the most interesting of all is the Acadian or saw-whet, one of the smallest of the family and little known. It is far from common, being met with only at intervals. Its note, which closely resembles the filing of a large saw, occasionally betrays it; while at the same time it has a tendency to stray into barns and out-buildings, thus affording an opportunity for capture.

As it is not generally known, a description may be of some benefit. "Upper parts, including wings and tail, uniform chocolate-brown, spotted with white; under parts white, thickly streaked lengthwise with the color of the back; face, white."

In general appearance, they are the same as all owls, but when seen in the woods have a somewhat comical appearance, owing to their wise look for so small a bird.

We have often heard of the shrikes, or butcher birds, that capture small birds and impale them on the thorns of bushes. Many of us have wished to see them, and wondered where and when they were to be found. Now is the time. Any clump of bushes or young second-growth is a likely place to find them, for there are two species which visit us every winter and frequent these places. These are the great northern and loggerhead shrikes, the latter being most common; both bear a general resemblance, but differ mainly in size and in markings on the under parts. One can find them almost any day, perched on the topmost branch of some tree or bush, steadily eyeing the surrounding bushes in search of some victim, while on a thornbush near by will be found numberless moles, mice, and an occasional bird, awaiting the appetite of the marauder.

Aside from the goldfinches, many other birds of different species, instead of migrating with the rest, remain behind, and are to be found, on almost any pleasant day, in the warmer and more secluded parts of the swamp. Among these are the robin, golden-winged, downy, and hairy woodpeckers, the white-bellied nuthatch, and chickadees. These last are, perhaps, the most numerous of all our winter birds; whole flocks roam from one end of the swamp to the other, and I think there is no pleasanter sound to be heard in the woods in winter than to hear their clear "chick-a-dee-de-de-de" from a score of little throats, or to see them clinging to the branches and acting as familiarly as though no one was within sight or hearing. An occasional meadow lark will be flushed from the tall grass in some sheltered spot, while on the open streams will be found black ducks and mallards, whistlers and mergansers of two species, the hooded and buff-breasted or common sheldrake.

Truly, then, with all this material awaiting us, the fields and forests will be found inviting, and you who have never traversed them in winter do so now, and get a new interest awakened in them.

IT is not long since we spoke of the benefits conferred on the farmer by the inventor. The following statement is a good illustration of our views as then presented. It is taken from our contemporary, the *New England Farmer*. "By the use of mowing machines and horse rakes and a horse hay fork, two boys in Connecticut last summer cut, raked, and helped to stow away 100 tons of hay, while their father was disabled from work by illness. Under such conditions a farmer is apt to feel like blessing the man who invents labor-saving machinery."

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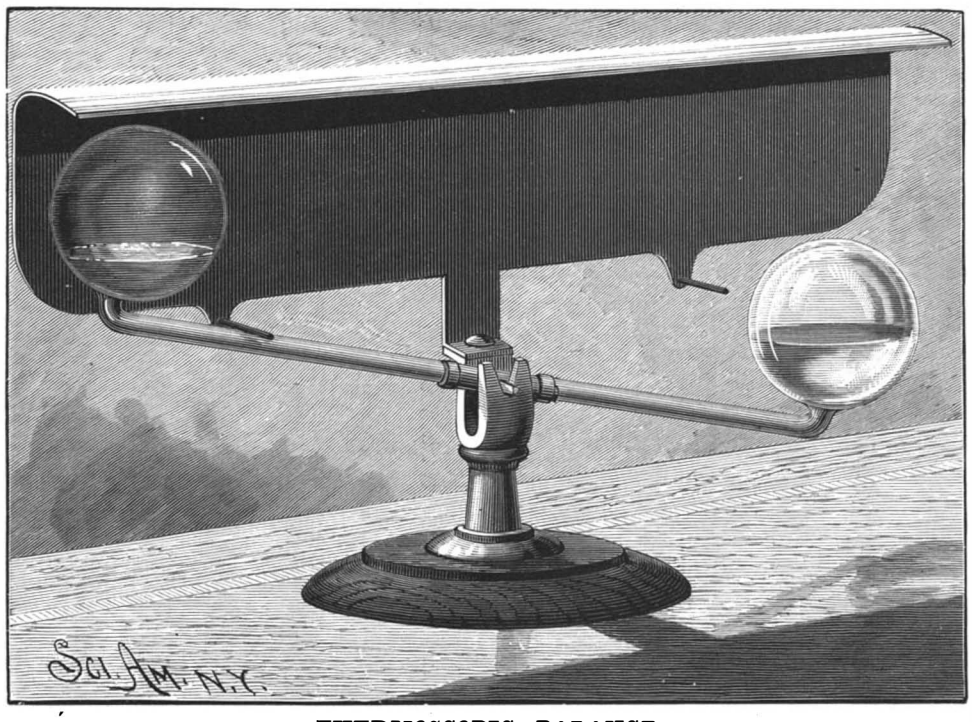
THERMOSCOPIC BALANCE.

BY GEO. M. HOPKINS.

The action of this instrument is due to the facility with which liquids evaporate in a vacuum. A small amount of heat is sufficient to vaporize the liquid to the extent required to secure the desired action. The instrument is provided wih a glass tube bent twice at right angles, and having a bulb blown on each end. The tube and the bulbs are partly filled with water, and a vacuum is secured by boiling the water in the bulbs before sealing them. The center of the tube is furnished with V-pivots, which rest in bearings in the top of the forked column. The column also supports a metal screen, which is bright one side and black on the other. Two pins project from the shield, to limit the movements of the glass tube and bulbs.

When the instrument is in use, the screen is placed toward the source of heat, and when radiant heat strikes the bulb which is unshielded by the screen, the water in that bulb is vaporized, and sufficient pressure is produced to drive the water upward into the bulb behind the screen. When a little more than half of the water has been in this manner forced from the lower to the higher bulb, the upper bulb preponderates. The tube and bulbs are supported on their pivot so as to secure unstable equilibrium, so that, when the upper bulb begins to descend, it completes its excursion at once, and exposes the full bulb to the radiant heat, at the same time carrying its empty bulb behind the screen, where it cools. The transfer of the water from the full bulb to the empty one now occurs as before. This operation is repeated so long as the bulbs are exposed to the action of radiant heat. The oscillations may be quickened by smoking the sides of the bulbs remote from the screen, and still greater rapidity of action may be secured by concentrating the heat on the bulbs by means of condensers or reflectors.



THERMOSCOPIC BALANCE.

The Duration of the Sun.

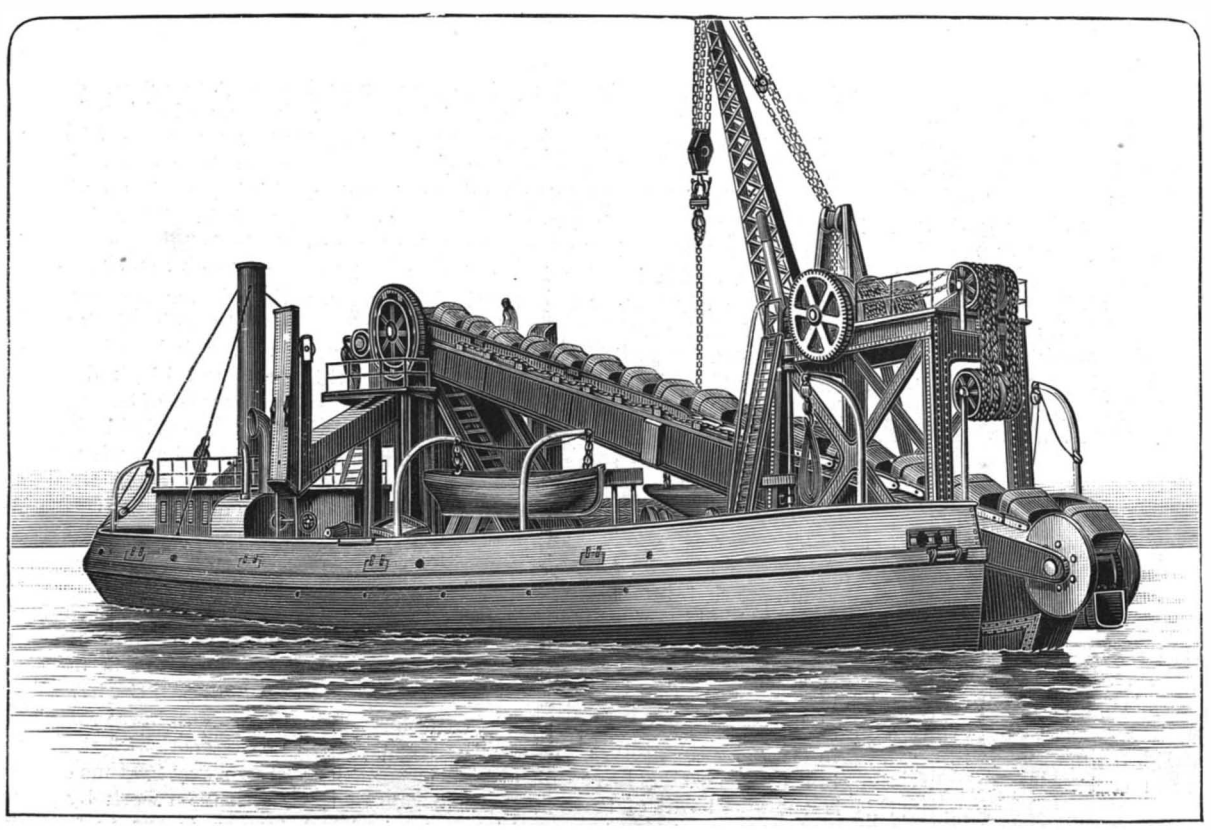
The *Builders' Weekly Reporter* (London) has an interesting account of a lecture at the Royal Institute, given by Professor Sir William Thomson, on the latest dynamical theories regarding the "probable origin, total amount, and possible duration of the sun's heat." During the short 3,000 years or more of which man possesses historic records there was, the learned physicist showed, no trace of variation in solar energy; and there was no distinct evidence of it even, though the earth, as a whole, from being nearer the sun, received in January 6½ per cent more heat than in July. But in the millions of years which geology carried us back, it might safely be said there must have been great changes. How had the solar fires been maintained during those ages? The scientific answer to this question was the theory of Helmholtz that the sun was a vast globe gradually cooling, but as it cooled, shrinking, and that the shrinkage—which was the effect of gravity upon its mass—kept up its temperature. The total of the sun's heat was equal to that which would be required to keep up 476,000 millions of millions of millions horse power, or about 78,000 horse power for every square meter—a little more than a square yard—and yet the modern dynamical theory of heat shows that the sun's mass would require only to fall in or contract thirty-five meters per annum to keep up that tremendous energy. At this rate, the solar radius in 2,000 years' time would be about one hundredth per cent less than at present. A time would come when the temperature would fall, and it was thus inconceivable that the sun would continue to emit heat sufficient to sustain existing life on the globe for more than 10,000,000 years. Applying the same principles retrospectively, they could not suppose that the sun had existed for more than twenty million years, no matter what might have been its origin—whether it came into existence from the clash of worlds pre-existing, or of diffused nebulous matter. There was a great clinging by geologists and biologists to vastly longer periods, but the physicist, treating it as a dynamic question with calculable elements, could come to no other conclusion materially different from what he had stated. Sir William Thomson declined to discuss any chemical source of heat, which, whatever its effect when primeval elements first came into contact, was absolutely insignificant compared with the effects of gravity after globes like the sun and the earth had been formed. In all these speculations they were in the end driven to the ultimate elements of matter, to the question—when they thought what became of all the sun's heat—what is the luminiferous ether that fills space, and to that most wonderful form of force upon which Faraday spent so much of the thought of his later years—gravity. The lecture was heard with deep interest and close attention.

IMPROVED MARINE DREDGER.

The twin screw dredger Dolphin was recently constructed for the Colonies, under the direction of Sir John Coode, assisted by Mr. Wm. Matthews, C.E., and is especially designed, says the *Engineer*, for harbor improvements in the West Indies. The dimensions are:

	Ft.	In.
Length between perpendiculars	130	0
Breadth moulded	30	0
Depth	8	0
ENGINES—Compound surface condensing, I.H.P. 250		
Stroke of pumps		14
Diameter of high pressure cylinder		16½
" low pressure "		33
Length of stroke		24
Diameter of air pump		11½
" circulating pump		6½
" feed pumps		2½
" bilge pumps		2½

The boiler is of steel, for a working pressure of 90 lb. per square inch. The bucket ladder works through a well formed in the center of the vessel, and dredges to a depth of 33 ft. below the water level, and the buckets are made wholly of steel, and are capable of lifting 250 tons of free soil per hour. Triple-geared winches are supplied at bow and stern for working the mooring chains, the barrels of which can be worked independently or conjointly, as required. The cabins for the officers and crew are of the most complete description; those of the former being fitted on starboard side of the well, and consist of rooms for the captain, mate, and engineers, also mess room. All the rooms are large and efficiently lighted and ventilated. A powerful crane is erected at forward end for overhauling the buckets, hoisting gear, etc.



THE DREDGER DOLPHIN.

Hydraulic Dredging at Washington.

At a recent meeting of the Engineers' Club of Philadelphia, a paper by Conway B. Hunt was read on hydraulic dredging machinery.

The paper mentions the early application of the principle of hydraulic dredging, that is, the mixing of dredged material with water and then removing the mixture by suction or otherwise; and after referring briefly to the Roy Stone and Bowers dredges as typical machines, describes in detail the Von Schmidt dredge. Two of these dredges are engaged on the improvement of the Potomac River at Washington, D. C., under the United States Government. Each is 100 feet by 50 feet, with a semicircular bow, around which travels a vertical suction pipe, 22 in. in diameter, and telescopic. At its foot is a conical hood, beneath which works a rotary excavating plow, 8 feet in diameter. The suction is produced by a powerful centrifugal pump, run by a 200 horse power engine.

The discharge pipe is 20 in. in diameter, has rubber hose joint connections, and is carried to the shore on pontoons. The material was mixed with from three to ten times its volume of water, and discharged at distances up to 3,500 feet from the dredge, and at from 6 to 10 feet above water. A year's record shows an average of 175 cubic yards per working hour, and 2,300 yards per day, for each dredge. The work was done, by contract, at prices of 12·37 cts., 15 cts., and 15·45 cts. per cubic yard, which includes the cost of levees to confine the semi fluid material, drains to carry off the water, etc. The final estimates were specified to be taken by cross sections of the completed fill after it had become solidified and compacted. In conclusion, it is noted that the devices and details of hydraulic dredging machines are the subjects of numerous patents, and their most efficient combination may be long deferred. The large number of machines that are still in the experimental stage of development would indicate that the best results attainable from this class of dredges have not yet been accomplished.

A New Sugar Process.

The details of the process vary with quality of beets. To a vat containing the secondary products to be treated are added calculated quantities of diluted hydrochloric acid and milk of lime at 25° B. The mass is heated to the boiling point by a steam coil. In a separate vat the product is diluted with water at 75° C. to 23° B., and subsequently run through Puvrez filtering bags. The filtrate is clear in color, and is received in a measuring tank, from which it is run into the diffusion battery. In the latter but few changes are necessary. It is said that by this method an additional 1 per cent sugar is extracted from the beet, and the white sugar obtained can be at once placed upon the market.

THERE were exported last season from Prince Edward Island 91,000 cases of lobsters.

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THE NORTHERN LIGHTS.

When, in 1752, Franklin succeeded, through a kite sent up into a storm cloud, in obtaining an electric spark at the extremity of the cord, which had been made a conductor through the rain, it was no longer possible to doubt that lightning was but an immense electric discharge between two clouds, or a discharge between a cloud and the earth. This discovery was of great importance, since it connected with the laws of physics certain phenomena which, until then, had passed for marvelous, and in which nothing but supernatural and mysterious manifestations were seen.

The aurora borealis, which is more difficult to understand, and which necessitates more extended scientific notions, has remained much longer unexplained. This enigmatic phenomenon was especially striking to the imagination of ancient peoples. It was regarded as an omen of inauspicious events, and the historians who describe it affirm that, at times, armies have been seen passing through the bloody heavens, and that the clash of arms has been heard.

It is now known that the aurora borealis has the same origin as lightning, that it is one of the visible manifestations of atmospheric electricity, and that it is due to slow movements of that fluid, while lightning is the result of violent motions. The effects of the aurora and of the thunderbolt are absolutely different; but between them there is an intermediary that connects them, and this is heat lightning.

These elementary notions are now the property of science; but the study of the aurora has hitherto been only partially outlined. Travelers and physicists have, indeed, given numerous descriptions, but it has remained to find the bonds that unite these so important phenomena in the economy of the globe, to study the causes that set them in action, to observe the correlations that they may offer, and to discuss theories. This is a labor that Mr. S. Lemstrom has been engaged in for several years, and we now propose to analyze the results published by this great Finnish physicist.

The author of this important work, who has long been occupied in the study of the aurora borealis, so frequent in his country, was attached to the polar expedition made in 1868 by Nordenskjold. He was led to begin a series of important observations. In 1871 he visited Finnish Lapland, and, after a series of ingenious researches, constructed an apparatus that permitted him to artificially reproduce the light of the aurora, and to present science with a summary of new and incontestable facts.

Mr. Lemstrom has observed a large number of auroræ, and before touching upon theoretic questions, we shall give his description of one of the phenomena that seems to him to be the completest. On the 18th of October, 1868, the steamer Sophia was nearing the coast of Norway, after battling with a furious sea for three days in succession.

"To the west of the horizon we remarked two strata of clouds that were clearly separated by a blue band of the heavens, crossed by a band striated with a pale yellow. It was the feeble beginning of an aurora, whose splendor was soon to surpass all the phenomena of the same kind that we had up till then observed. The edges of the upper stratum of clouds gradually lighted up, and we soon saw isolated flames issuing from them that sometimes rose to the zenith. Suddenly, the phenomenon embraced the entire horizon. Everywhere were flames, everywhere were jets of brilliant light, yellow below, green in the center, and reddish violet above. In an instant, all the rays united in a regular and dazzling crown, situated in the heavens to the south of the zenith. When the phenomenon reached the maximum of its intensity, it reminded us of the immense vault of a temple, with a brilliant chandelier in the center. The apparition lasted but a few minutes, but, on vanishing, left behind it a luminous zone between the banks of clouds. From the upper bank there continued to emanate, at short intervals, isolated rays that rose to the zenith, and there formed the fragments of a crown. The edges of the banks of clouds remained luminous, although the rays had disappeared."

According to Mr. Lemstrom, Fig. 1 gives an idea, although a feeble one, of the phenomenon at its height. It reproduces only half of the horizon, and the reader may supply the missing portion of this grand spectacle in imagination. The streams of light verging toward a common center were alternately rose colored and pale yellow, and overlooked an immense violet zone. The rosette in the center was of a beautiful red, and stood out upon a greenish blue circle.

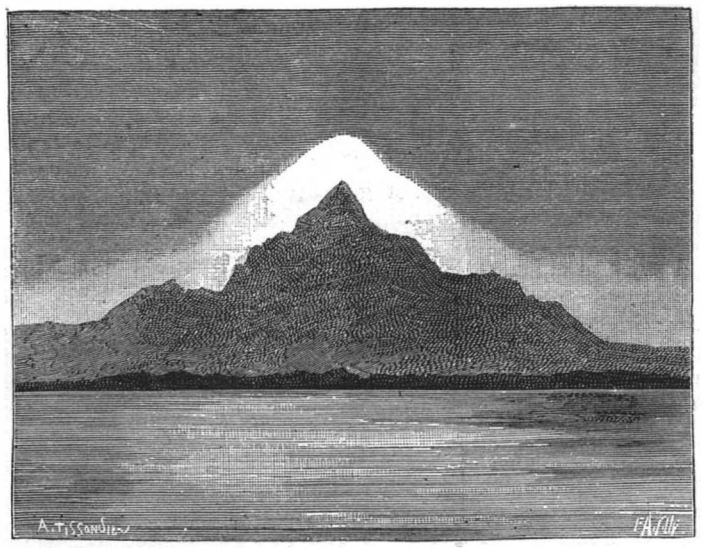

Fig. 4.—AURORAL LIGHT AROUND THE SUMMIT OF A MOUNTAIN.

Fig. 2 represents an aurora that was observed on the 19th of November, 1871, in Finnish Lapland. At the beginning, and at 30° above the horizon, it formed an arch from whence rose waves of light, and which gradually ascended. The figure shows it when it had reached about 60° above the horizon. The base of the aurora was yellow, and the oblique and very brilliant rays were, slightly higher up, rosy, violet, and blue. The colors of the polar light are usually clear and bright, but never did they exhibit greater luster than on this occasion.

Fig. 3 gives an idea of the variety of forms that the phenomenon may affect. It represents an aurora that was observed at the presbytery of Enare on the 16th of November, 1871. The aurora this time took on the form of a glowing red band, curved as shown in the figure. The two extremities bordered on yellow and green.

There is another form of aurora frequently observed in northern countries, and that is the one that is seen to occur above clouds, and that has the appearance of a wide piece of drapery with undulating folds. As it is the form most usually represented, we shall not dwell upon it. On the contrary, we shall speak of other phenomena of the same origin, and much less known, that Mr. Lemstrom describes. It concerns those auroral lights that shine at the edges of clouds, or that form around the tops of the mountains in Spitzbergen or in the Alpine districts of Lapland. According to the Finnish observer, it would be impossible to tell by the naked eye whence this light comes, but, by means of a spectroscope, we find that it is of the same nature as the aurora. Sometimes, these strange lights take on the form of flames of but little brightness, which, at short intervals, rise from the crest of the mountain and suddenly vanish (Fig. 4).

Fig. 2.—AURORA BOREALIS OBSERVED IN LAPLAND.

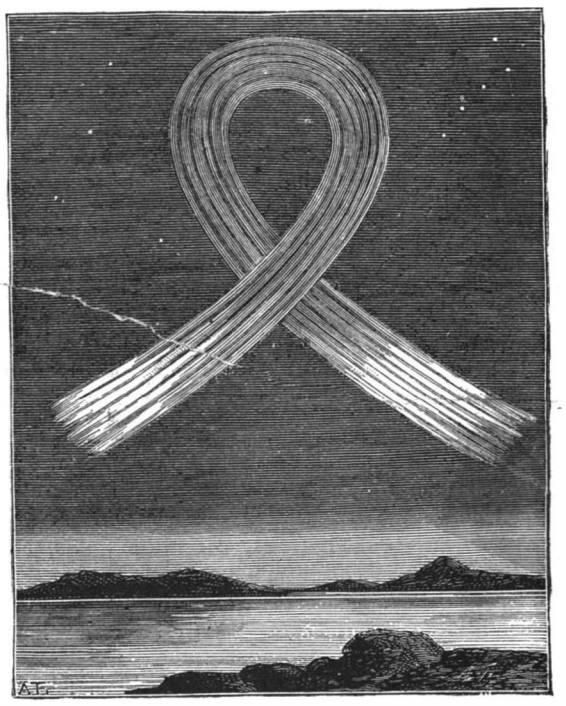

Fig. 3.—AURORA BOREALIS OBSERVED AT THE PRESBYTERY OF ENARE.

These phenomena sometimes exhibit themselves at the level of the earth's surface, or upon the roofs of houses.

Finally, Mr. Lemstrom describes the diffuse light which sometimes fills the atmosphere of the polar regions, thus proving that the phenomenon shows itself from time to time in the vicinity of the earth itself.

Meteors of the same nature as the light of the auroræ boreales do not occur solely in the polar regions, and the author demonstrates, not without attaching much importance to it from the standpoint of the theories to which he has been led, that they are observed in other countries of the earth. In Peru, Bolivia, and Chili the summits of the mountains are often seen illuminated by a brilliant light. This light, which occurs especially in summer, has been compared to heat lightning by scientists.

Similar observations have been made in the Swiss Alps. Dr. De Saussure has seen electricity escape through all the projecting parts of objects, and the same phenomena have been observed upon the high plateaus of Mexico. Again, we may cite the fact that Brewster observed a light upon a church tower during an aurora borealis. In every country phenomena similar to polarized light may occur.—*La Nature.*

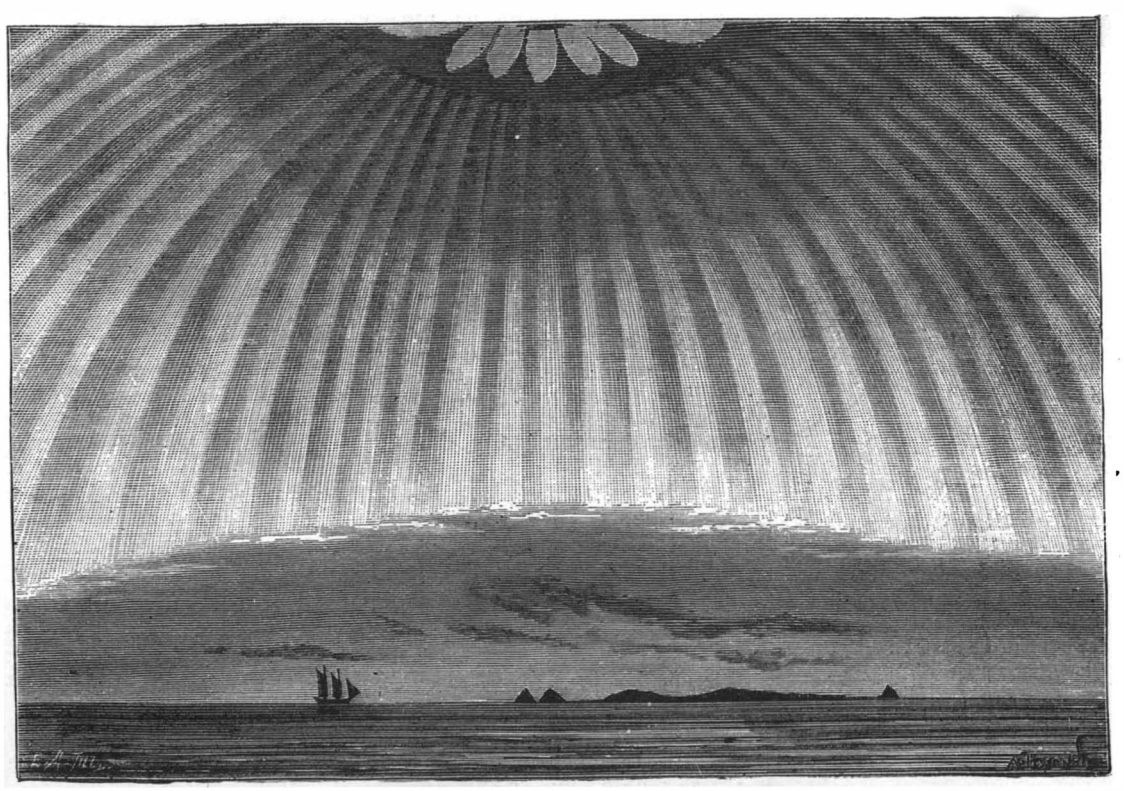

Fig. 1.—AURORA BOREALIS OBSERVED NEAR THE COAST OF NORWAY.

In 1886, 17 Gloucester fishing vessels were lost, worth $115,800, and 115 fishermen never came home. The year was remarkable for the small inshore catch, almost all the fishing being done on the high seas.

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The Latest Yankee Craze.

At the forthcoming American Exhibition in London, we are promised, among other novelties, a house of straw, which is now being made in Philadelphia. This house is to represent an American suburban villa, announced to be "handsome and artistic in design," two and a half stories high, and covering a space of 42 feet by 50 feet. It is constructed entirely of materials manufactured from straw—foundations, timbers, flooring, sheathing, roofing, everything in fact, including the chimneys—the material being fire proof as well as water proof. The inside finish is to be in imitation rosewood, mahogany, walnut, maple, ash, ebony, and other fine woods, the straw lumber taking perfectly the surface and color of any desired wood. This straw house is, in the first place, to illustrate Philadelphia's commercial, financial, and industrial interests by means of large photographs of the leading buildings; but it will also demonstrate how far the inventive Yankee has succeeded, not in showing us how to make bricks without straw, but how to produce timber from straw. If, after this brilliant exhibition of inventive genius, we do not bow down and worship him as the "licker" of creation, we may consider ourselves lost to all sense of what is proper under the circumstances. —*Iron.*

EFFECT OF A TORPEDO ON AN IRONCLAD.

The British government lately strengthened up the bottom of the old ironclad Resistance, and tried the effect of firing off a 90 lb. guncotton torpedo against the vessel. To the surprise of every one, the ship was not seriously damaged. The *Engineer* comments upon the experiment as follows:

The Resistance experiments so far tend to demonstrate that the total disablement or destruction of a modern ironclad is not so easy as many people imagined. It was too hastily assumed that the explosion of a charge of 90 lb. of guncotton in contact with any portion of the hull under water would have such destructive effect as to overcome the protection afforded by a thick lining of coal and the cellular system of construction now always adopted in vessels of war. There are, however, certain considerations attached to this experiment which, if duly weighed, should reassure the advocates of the torpedo, and restrain the exultation of naval architects within reasonable bounds. We shall endeavor to place these before our readers briefly and impartially, reserving a fuller summing-up until the remaining experiments are concluded, as they are of greater importance than any of those preceding. It is the more essential to do this because the *Times*, in a leading article of November 3, leads us to believe that as this attack failed, in the broad sense of the word, similar attempts under different conditions would have a like result; and that although serious damage would be caused, the ship would remain "floating and seaworthy, with her offensive powers not materially impaired." We are not prepared to accept this conclusion, for the following reasons:

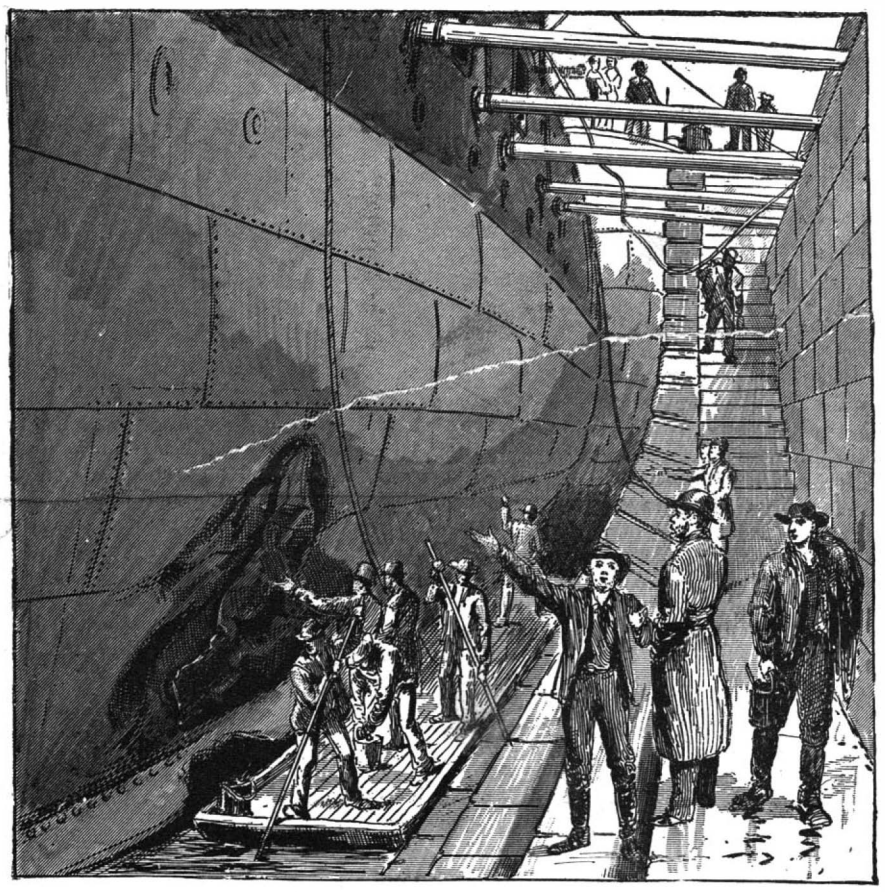
First, let us consider the general effect of a submarine explosion. It closely resembles the action of gunpowder when ignited in a gun. We know that in the latter case a quantity of heated gas is formed, which in its power of expansion exerts force in all directions. Prevented from expanding by its rigid confinement, except in the direction of the bore, the gas attains its object by the displacement of the projectile. This is, in fact, the line of least resistance. When the same explosive is ignited under water, the heated gas presses outward in all directions, forcing the surrounding molecules of water against their neighbors, which are, in turn, propelled forward with great violence. This effect continues until the back pressure of the liquid medium equals the now reduced pressure of the gas due to its expansion in the space vacated by the displaced water, which is likewise to some extent compressed by the action of the gas. Though brought actually to a state of rest, the surrounding water is under the influence of great pressure, which by the law of fluids is transmitted equally in all directions. When a vessel is sufficiently near the explosion to be struck by the water which has been so violently disturbed, it will act upon her like a huge projectile, and it is obvious this range will be in proportion to the amount of explosive employed. This, combined with the resistance her hull offers, will also determine the effect produced.

If the charge is too near the surface of the water, the liquid layer above it will not restrain the liberated gas sufficiently to allow of its full power being exerted in other directions, and hence permits its escape into the atmosphere, throwing up the water in its way to a greater or less height, according to the thickness of the layer. The spectacular effect, therefore, afforded by the upheaval of a large and lofty column of water is no criterion of the efficiency of a submarine explosion, but, on the contrary, shows that much of its energy has been expended in the wrong direction. The amount of submersion to give the greatest lateral effect to different charges of explosive has been ascertained by practical experiments. For 100 lb. of gunpowder, it is stated to be 10 ft., while for the same quantity of guncotton it should be 15 ft. As the charge employed against the Resistance was 90 lb. of guncotton placed 10 ft. below the surface, it is probable that some loss of power was sustained in the manner we have indicated. At a greater depth also the charge would have been to some extent under the vessel, where its explosive effect would have been more severe, and where the construction of the hull cannot be as strongly fortified with coal as was the case in the Resistance. We are unable to state why a depth of 10 ft. was selected on this occasion; but it may be due to the fact that up to a late date most of our locomotive torpedoes have not carried a larger charge than 40 lb. of guncotton, and are usually run at 10 ft. below the surface.

Considerable stress has been laid on the fact that in this experiment the charge was in actual contact, and yet did not effect complete penetration. It is even gravely asserted that an actual torpedo would have rebounded a certain distance before explosion took place, and this would diminish its effect. In the first place, the detonation of guncotton is practically instantaneous, so that impact and explosion would be simultaneous. We are hardly prepared to allow an inch rebound, but will concede that until actual proof convicts us of error. In the second place, it is possible that a distance of three or four feet between charge and ship would rather augment than diminish the effect produced in the case of such an explosive as guncotton when sufficiently immersed. It is possible the intervening water thrown against the side of the ship would do more damage than the gas liberated in actual contact. At any rate, experiments some years ago with smaller quantities of both dynamite and guncotton showed that when exploded 4 ft. from the bottom of a ship, enormous damage was inflicted on her.

Although it is generally estimated that guncotton is about four times more powerful than gunpowder, this does not appear to hold good under all conditions; while, on the other hand, for certain purposes, ten times the amount of gunpowder would not produce the same result. This is proved by the ease with which the strongest chain cable and wire rope can be ruptured by a small charge of guncotton, which even more than ten times the amount of gunpowder could not accomplish. This is due to the peculiar shattering action of detonated guncotton, which the slower burning substances does not possess, its characteristic being more of the nature of a push than a blow. Taking into consideration the method in which the hull of the Resistance had been strengthened for this experiment, and the exact locality chosen for the explosion, it is probable that less than twice the amount of gunpowder would have caused a more complete breach through the coal protection. The torpedo is stated to have had everything in its favor; whereas, in our opinion, all the advantages were on the side of the ship. The attack was made at her strongest point, where the coal was specially disposed, and her shape under water lent no assistance to the explosive. To assume from this that if a similar torpedo struck lower down, or further aft, or against the propeller, the ship would still have "her offensive powers not materially impaired," is to express an opinion with which few will be found to concur.

Under the alternative circumstances mentioned, half the amount of explosive might practically disable the vessel, though her flotation need not be overcome. Whitehead torpedoes need not necessarily be limited to a depth of 10 ft., as by slightly strengthening their construction they could be run 20 ft. below the surface. We presume it will be allowed that this would increase their destructive power, especially in the vicinity of engines and boilers, which now occupy so much space. In a similar manner there is no difficulty in increasing the charge of a locomotive torpedo to a point at which it becomes irresistible, whatever system of internal protection may be devised. This has, in fact, been going on for some time; more than one nation possesses torpedoes armed with 100 lb. of guncotton, and if we do not, it is simply because former experiments led us to believe sufficient damage would be caused by a less quantity. We can only consider that disproved on demonstration by further trials under conditions less favorable to the ship, and we venture to predict some delusions will then be dispelled which this particular experiment seems to have occasioned.



TORPEDO EXPERIMENTS AT PORTSMOUTH—DAMAGE DONE TO THE PORT SIDE OF H.M.S. RESISTANCE.

Steel Wire Brush Patent.

Before Judges McKennan and Acheson of the United States Circuit Court for the Western District of Pennsylvania, at Pittsburg, Pa., No. 16 of November term, 1886, a question arose as to whether a steel wire brush for cleaning castings, and a steel wire brush for cleaning boiler flues, was an infringement on what is generally known as the Wright patent, No. 59,733, and the reissue, No. 2,598, owned by Joseph McArthur, of New York city.

The Wright patent consists of a wooden block with a series of pairs of holes. A bundle of wire splints is doubled and the ends inserted in the holes, being held by the wooden bridge between the holes and by a wooden back screwed to the block.

Joseph H. Davis, of Sewickley, Pa., the defendant, under his casting brush patent, No. 232,600, the construction of which consists in the doubling of the wire splints and inserting in one hole of a wooden block, and fastening by means of weaving a wire through the loop, the wire being held in place by a wooden back fastened on by driving wrought iron nails through the block and back and clinching on the back, thus making the block and back practically inseparable.

The Davis flue brush patent, No. 181,416, is made by sticking the wire splints through holes in an iron cylinder, there being no wood about its construction.

Several cases had been tried in other States involving the validity of the Wright patent, which had resulted in Mr. McArthur's favor, but after exhaustive argument in the case at Pittsburg, Pa., the court held the Davis brush not to be an infringement on the Wright patent.

How Long Should a Nervous Patient be Treated?

The question of how long treatment should be continued in a neurotic case when no evident benefit is produced has recently been raised in a Hamburg law court. A medical man, says the *Lancet*, having as a patient a merchant suffering from "nervousness," treated him by galvanism. Altogether he galvanized him 445 times, but the nervousness did not disappear. Then came the matter of fees. The sum claimed was $556. The merchant disputed this on the ground that the treatment ought not have been continued so long, as it was not producing any benefit. The court referred the matter to the medical board, which gave as its opinion that the doctor ought to have asked the patient, after some fifty sittings, whether he would like to continue them, as it was doubtful whether the treatment was doing any good. The court, however, declined to accept this view, holding that it was for the patient to say when he had tried the treatment as long as he was disposed to pay for it, and so gave judgment for the full amount claimed. This judgment seems to accord with the principle that applies to newspaper subscriptions. A man must pay for his paper as long as he takes it from the post office.

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TORPEDO BOAT ARMED WITH PNEUMATIC DYNAMITE GUNS.

In former issues of the SCIENTIFIC AMERICAN we have given illustrations and detailed descriptions of the pneumatic dynamite gun invented by Lieutenant E. L. Zalinski, of the U. S. Artillery Corps. This gun, it will be remembered, was designed to throw a projectile loaded with dynamite or nitro-glycerine by means of compressed air; and so successful were the experiments carried on with it at Fort Lafayette, under the supervision of a board of naval experts, that Congress eventually appropriated $350,000 for building a swift torpedo boat, large enough to go to sea, and to be armed with three of these guns. Contracts for this boat have been signed with the Cramps.

The upper view in the accompanying engraving is a longitudinal vertical section, the lower one being a plan view. The following details regarding the boat we take from the *Sun*. The boat will be 250 ft. long, 26 ft. beam, and will draw 8 ft. of water. Her displacement will be about 800 tons. The engines will be of the triple expansion type, of the best known design, and the guaranteed power will be 3,200. She will be propelled by twin screws, and it is expected that the guaranteed speed of 20 knots an hour will be exceeded.

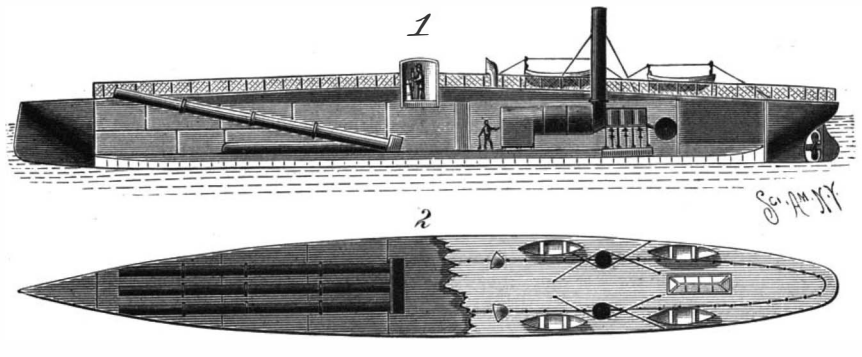
The three dynamite guns are to be placed side by side, at the elevation indicated in the upper view. They are to be fired in their places, but their range can be varied by increasing or diminishing the charge of air let in behind the projectile. An extreme range of one mile is put down in the contract, and the weight of gelatine to be thrown is 200 pounds; but the guns, as now building, will throw 400 pounds instead of 200 pounds, and the effective range will probably be about two miles. Air chambers and compressors of sufficient size and power are provided to enable fifteen shots to be fired to the distance of one mile without stopping; but if the boat were heading for the enemy at full speed, thirty shells could be thrown before the air would be exhausted and the cruiser obliged to turn tail. Thirty shells would mean the explosion of 12,000 pounds of nitro-glycerine about the enemy.

In fixing the gun permanently in its place, the designer has followed out the old idea of making the ship simply a floating gun carriage. The new British cruiser Polyphemus is built on the same idea, and there are other floating gun carriages. In this cruiser the firing is entirely under the control of the officer in the pilot house. He has simply to head his boat for the enemy, dash ahead at full speed, and blaze away. The trained pilot, even in the excitement of battle, would steer his ship instinctively, so there would be little trouble with the aim, except, perhaps, in getting the range.

Each gun can be fired once in two minutes, or the three successively in two minutes.

The new cruiser has a freeboard of about four feet above water. This is quite enough to enable her to travel anywhere along the coast. She carries enough coal to travel 5,000 miles at 12 knots an hour. This would take her about 700 miles at full speed. She could probably turn a complete circle of a radius of twice her length in between two and three minutes. She can carry 100 or even a much greater number of torpedoes with her when going on a cruise. To show how she compares with the best of the latest English built torpedo boats, it may be said that the Destructor, built for the Spanish Government, carries but ten torpedoes, although she has five tubes to fire them from, and this is the usual number carried. The range of the best of these foreign torpedoes is 600 yards, under the most favorable circumstances, and in a seaway not more than 100 or 200 yards. The exploding charge is 75 pounds of gun-cotton, an explosive that is exceedingly inefficient when compared with nitro-glycerine.

The new boat will also be armed with the usual rapid-firing guns which are placed on foreign torpedo boats. These are to be used in battle with craft like herself and small boats. It is expected that she will be finished in six months.



TORPEDO BOAT ARMED WITH PNEUMATIC DYNAMITE GUNS.

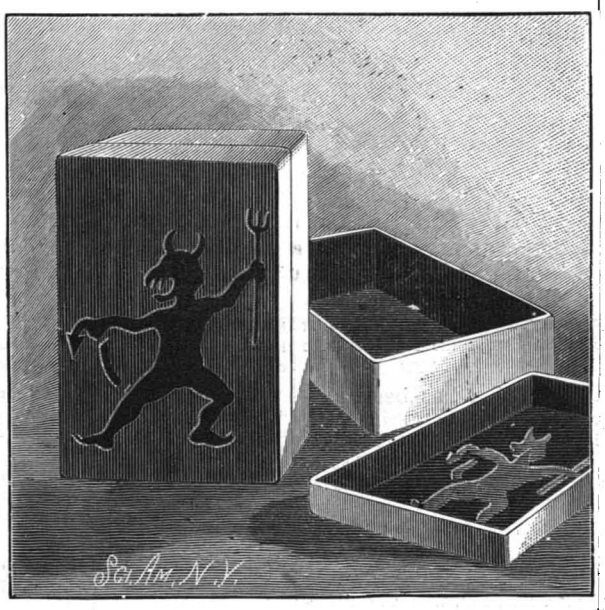
The Strength of Snails.

Perceiving a common snail, *Helix aspersa*, crawling up the window blind one evening, it occurred to me to try what it could draw up perpendicularly. Accordingly, I attached to its shell four reels of cotton, fastening one after the other until I ascertained that a greater load would exceed the limit of its strength. I then weighed the entire load, and found that it weighed 2¼ ounces, while the snail weighed only ¼ ounce. Thus it was able to lift perpendicularly nine times its weight. I then made an experiment with a larger snail, weighing one-third ounce, the load being composed chiefly of the same material as the last, but so placed as to be drawn in a horizontal position on the table. Reels of cotton to the number of twelve were fastened to it, with a pair of scissors, a screw driver, a key, and a knife, weighing altogether seventeen ounces, or fifty times the weight of the snail. The same snail when placed on the ceiling was able to travel with a weight of four ounces suspended from its shell. I next tried it on a piece of common thread, suspended and hanging loose with another snail of its own weight, which it carried up the thread with apparent ease. After this I tried it on a single horsehair strained in a horizontal position, but it had then enough to do to crawl over this narrow bridge without a load.—*E. Sandford, in Zoologist.*

CHEVREUL'S BLACK.

T. O'CONOR SLOANE, PH.D.

The production of absolute black by a pigment or surface coloration has been shown by Chevreul to be an impossibility. No substance is known that does not possess the power of reflecting light to some extent. If paper is blackened, its surface will reflect rays that can act powerfully upon the sensitive plate in a camera, even if the eye, by convention and association, would determine it to be actually black. The same is to be said of black silk and velvet. The latter, more than any other substance, approaches real black. It is an object of common observation that all colors show much more strongly in velvet than in any other material. The reason for this is that, owing to the depth of the pile, the light undergoes multiple reflection.* The percentage of white light is diminished with each reflection, and the colored rays become less and less contaminated with those of other hues. The same reasoning applies to black velvet. The light by multiple reflection from its substance is more and more absorbed, and the familiar intense black is the result. A piece of this material, placed upon cloth or silk, always appears, and is, the blacker. In choosing velvet for such experiments, care must be taken not to use a blue black. The dead black is the proper one to select.



CHEVREUL'S BLACK.

Black being the absence of color is producible by excluding light. The production of the velvet black, we have seen, depends on the mechanical texture of the goods. Nothing is so black as a perfectly dark room. Carrying out these principles, Chevreul devised the wonderfully ingenious way of producing a true black which we illustrate.

He lined the interior of a box with black. Pigment, black silk, or black velvet may be used. In the cover of the box he made a hole, not too large, but bearing a certain ratio to the area of the cover. The size should not exceed one-tenth this surface. The spot thus produced reflected no light, as there was no surface. The interior of the box, by color and shadow, was prevented from reflecting any light, so that absolute blackness resulted. The blackest velvet or silk placed alongside of this spot appears lighter in color.

In constructing the apparatus illustrated, a famous proverb was selected as a theme, in which a certain personage is stated not to be so black as he is painted. The author of "English as She is Spoke" renders this proverb, "He not so devil as he is black." The blackness of this image is absolute.

A pasteboard box is lined with black silk or velvet, and any desired figure is cut through the cover. This may then be painted as black as possible, or before the figure is cut out, silk or velvet may be pasted over it, and the figure cut through pasteboard and covering together.

Then, on putting the cover in place, holding the box so that a side light will fall upon it, thus preventing direct access of light rays to the interior, the figure will stand out strongly black against a background which, but for the contrast, would itself be pronounced absolutely black.

To apply the most rigorous test, a member of the Society of Amateur Photographers of New York made a photograph of such a box. A carbon B dry plate was used, with thirty-five minutes' exposure, with stop *f*-30. The result was a negative perfectly transparent where the figure came, but strongly affected by the black box cover. Part of the cover was coated with black silk and part was painted, but both reflected light enough to produce a full photograph upon the plate.

A most interesting application of this principle on the large scale has been made of late years, especially by E. J. Marey, in the photography of moving animals.* With Chevreul's black as a screen, a plate can be exposed unaffected by the background, and will reproduce objects moving across the space with perfect fidelity.

The American Exhibition, London.

Recently we had an opportunity of going over the grounds of the forthcoming American Exhibition at Earls Court. The site is comprised in the triangle between Earls Court, West Brompton, and West Kensington stations, and is thus extremely well situated for easy access from all parts of London. The area that will be covered by the exhibition is about twenty-three acres, eight of which are on one and fifteen on the other side of the West London line, an iron bridge over the railway connecting the two portions. Although the work has been going on for some time, little is as yet seen of any building, the operations up to the present having been confined mostly to earth works, leveling, and draining. The land to be occupied by the exhibition might almost be called virgin soil, and all the drains had to be put in by the company. A good deal of soil has been moved, and some artificial mounds of considerable extent have been thrown up. In that portion of the exhibition which will be illustrative of the "Wild West," a large arena and a grand stand capable of seating 25,000 persons are in course of construction. The feature of special interest to engineers is, however, on the other side of the grounds, where the main building for the reception of the machinery and other exhibits is now being erected. The main hall has a frontage of brickwork 240 feet long, but the rest will all be constructed of iron and glass. The total length of this hall is 1,200 feet, and a special feature in its construction is the employment of old steel rails for the columns, purlins, and rafters, on a plan devised by Mr. H. G. Wynne, the engineer to the company. The whole of the framework is thus made out of old rails, the only portions specially made for the purpose being the cast iron sockets for the columns, cast steel shoes for the connections between purlins, rafters, and columns, and tie bars, which are made of ordinary round iron. There will be six bays of 30 feet each, and one bay of 60 feet. The columns are formed by two rails, riveted together with their flanges, so as to present a cross in transverse section. These are placed into cast iron sockets, which are set upon cement piers sunk in the ground. The outermost columns for the first and last spans are provided with struts, also formed out of rails, fixed to a sleeper, connecting the bottom of the strut with the foot of the column, this provision being made to provide against lateral strains; but the columns of the intermediate spans have no struts. The rafters are also made of rails, placed with the flanges uppermost, those for the short spans being in one length, but those for the long spans being fastened together by fish plates. The usual length of rail employed for the columns is 18 feet and 24 feet. There is a fall in the ground of about 2 feet to both sides from the middle of the building. To avoid the necessity of employing columns of different lengths, the ridge of the roof is carried parallel to the ground, and will therefore also show a fall of 2 feet on each side of the middle. This will be hidden by a loose louver, which is placed all along the ridge, so that the outline of the roof will appear straight and horizontal. The sides of the building will be of galvanized corrugated iron.—*Industries.*

PETROLEUM IN EGYPT.—At Jemsah, in Egypt, in boring for petroleum, ozokerite, or solid petroleum, has been found at a depth of 365 feet, and 15 feet lower a close grained coral has been struck. At another boring, slight traces of gas and oil have also been found.

* See SCIENTIFIC AMERICAN SUPPLEMENT, Nos. 579 and 580, for fully illustrated article on this subject.

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ENGINEERING INVENTIONS.

A spark arrester has been patented by Mr. John C. Albrecht, of Columbus, Ga. Combined with a draught pipe is a cone with curved volutes, and in its center and underneath it an inverted cone, with spark pockets, and other novel features, the sparks being returned to the fire box, the invention being an improvement on two former patented inventions of the same inventor.

A steam condenser has been patented by Mr. John McIntyre, of New York City. It is cylindrical in form, a central perforated or slotted casing being used in connection with the cooling pipes, with a regulating valve to open or close the perforations or slots, in such way that the cooling effect will be more instant and the temperature of the cooling parts more equal than in ordinary condensers.

A car coupling has been patented by Mr. George W. Giles, of Buffalo, West Va. In connection with a suitable drawhead, a weight and pin are joined by a flexible connection, the weight being adapted to overbalance the pin, and the weight being projected into the path of the drawbar, so that the entering drawbar will raise the weight, and thus permit the pin to fall by its own gravity into coupled position.

A car coupling has been patented by Mr. Wesley E. Roberts, of Hartford, Ky. The coupling link consists of a straight bar, with a wedge shaped pointed lug at each end, a spring being fastened to the under side, and the coupling being effected by an arm dropping in front of the lug after the link enters the drawhead, the device being simple in construction, and one which can be operated from the side or top of the car.

AGRICULTURAL INVENTIONS.

A mower has been patented by Messrs. James E. Nieth and Charles L. Thomas, of Independence, Iowa. This invention covers a novel construction and combination of various parts of the machine, so that it will operate with less friction than ordinary mowers, while being simple in construction and not liable to get out of order.

A plow has been patented by Mr. Thomas J. Eriom, of Union Church, Miss. It is an improved garden plow, with simple means for adjusting the gauge wheel to regulate the depth of working, and a breast bar for pressure by the operator to increase the propelling power and to give the plowman a better control of the plow, with other novel features.

MISCELLANEOUS INVENTIONS.

An attachment for elevator doors has been patented by Mr. Edward P. Walker, of Kansas City, Mo. It is an attachment designed to effect by the movement of the elevator car the automatic operation of the doors of the shafts, so that the elevator man is relieved of this duty.

A saw gummer has been patented by Mr. Eli Rogers, of Fulton County, Ind. The invention consists of a cam lever operating a spring arm on which is pivoted a tool holder, making a device which is simple in construction, durable, and effective in operation.

A hame has been patented by Mr. John E. James, of Mossy Creek, Va. It is so made that the shoulder of the horse will not be affected by heavy jars, and the hames may not only be fitted to any length of collar, but the point of draught may be shifted, so that the draught will be brought to the proper point.

A tongue support has been patented by Messrs. Charles W. Van de Mark and Calvin Moore, of Clyde, Kansas. The construction is such that the tongue may be supported so as to relieve the team of its weight, and the devices for supporting it are simple, inexpensive, and not likely to get out of order.

A fence post has been patented by Mr. John J. Kimball, of Naperville, Ill. Combined with side strips are rivets, spacing strips arranged between the side strips, clips formed with apertures, and staples arranged to pass through the apertures, making a cheap, durable, and efficient post for barbed wire fences.

A combined chair and lounge has been patented by Mr. Gustavus Hamel, of De Soto, Mo. The parts are so arranged that the back of the chair may be adjusted to any angle desired, and the attachment constituting the foot rest or foot of the lounge may be disposed beneath the main seat of the chair when not in use.

A harmonic keyboard for violins has been patented by Mr. James F. Poage, of La Plata, Mo. It is designed to enable the performer to produce harmonic high tones without great difficulty, and is attached to the neck of violins of the usual construction, the keyboard being a combination of pivoted finger keys with a pivoted stop plate.

A rein holder has been patented by Mr. William Tennison, of Mount Vernon, Ind. This invention covers an improvement in rein holders consisting of a skeleton frame adapted for attachment to a harness or for support upon a horse's back, and used for the purpose of supporting the reins out of the way of the animal's tail.

A collar button has been patented by Mr. Leopold Baer, of San Francisco, Cal. To the center of the button back is secured a tubular shank in which is a spiral spring, there being a knuckle joint by which a tongue may be held in three different positions, the device making a conveniently working button for holding the necktie in place.

A bridle has been patented by Mr. Benjamin S. Seaman, of Corning, N. Y. The cheek plate is formed with studs on which the blind sheet is adapted to be placed, and secured by a key plate constructed to engage with the studs, the cheek loop being secured to the cheek plate with the same stud plate and key plate which hold the blind.

A machine for bending carriage thills has been patented by Mr. Thomas E. Montague, of West Lorne, Ont., Canada. It is for bending wooden shafts or thills for buggies, sulkies, carriages, and other vehicles, and covers a novel construction and combination of parts and details, whereby thills of greater or less thickness can be bent, the machine operating very rapidly and automatically.

A nut lock has been patented by Mr. Jeremiah C. Butler, of Lexington, Mo. The construction is such that the key may be drawn off the bolt by the nut, and need not be bent out straight into the keyway of the bolt to prevent its locking portion engaging in the recesses of the nut as the latter is being turned off the bolt, the key needing only to be bent very slightly for adjustment into locked or unlocked position.

A trousers stretcher has been patented by Mr. Charles E. Ray, of San Francisco, Cal. The trousers are clamped below the waist band and at the bottom, the clamp at the waist band attached to a spiral or rubber spring, secured in fixed position at one end, while to the clamp at the bottom is attached a strap by which tension can be placed upon the trousers, and permanently maintained.

A log dog has been patented by Mr. Eugene H. Allman, of Mobile, Ala. It is made of heavy wrought iron, with a flat body portion, and having end points or fangs, and is applied to the chain by shouldered clips, all extra chains and dogs being dispensed with by its use, and when used on endless chains it being only necessary to point the logs in the logway, when the dogs take hold and bring them up.

An electrical weighing scale has been patented by Mr. Willis M. Hunt, of Glen Gardner, N. J. Combined with feeding hoppers arranged above the scale pan are valves operated by connection with the foot lever for discharging the hoppers, and combined therewith is an electro-magnetic holding and releasing device, which automatically stops the feed when the scale beam is tipped.

A boot or shoe stretcher has been patented by Mr. Lloyd Nottingham, of Norfolk, Va. Centrally pivoted levers have apertures in their lower end to receive pins with rounded outer ends, and above the pivotal point is an adjusting screw to separate the levers in stretching the boot or shoe, the levers being held apart by locking pieces, the device being simple, strong, and easily operated.

A combined bench and ironing table has been patented by Mr. Daniel H. Weller, of Boyertown, Pa. Combined with a reversible board with covered socket boxes are supports hinged to the legs of a bench, with other details, to make a desirable piece of furniture to serve the two purposes of a seat and a table to iron upon, with compartments for keeping the cloths used in ironing.

A window frame and sash has been patented by Mr. John E. Jones, of New York City. The construction is such that the sashes when closed are to all intents and purposes air tight, and wear and friction are removed from the packing strips, so the sashes may be raised and lowered without injury to the packing, the invention being an improvement on a former patented invention of the same inventor.

A tug fastener has been patented by Mr. Daniel T. Chambers, of Mansfield, Ohio. It is in the nature of a divided button, one portion integral with a shank that goes in the end of the single tree, and the other formed of two limbs, one completing the periphery of the button and the other extending up parallel with the shank and forming a part of the neck beside the button on which the trace is contained.

A tug fastener for single trees has also been patented by the above inventor. It consists of a tilting latch hinged upon a horizontal axis at or near the end of the single tree, with one hub adapted to lie longitudinally with the single tree and the other to project upwardly at about a right angle thereto, making an easily operated device for fastening the traces to a single tree.

A plaster fastener has been patented by Messrs. Forest M. Lampson, Alpheus M. Laning, and George W. Hogben, of Ripon, Wis. It consists of a metallic washer formed of thin sheet metal, slightly convex, and provided with a countersink in the center, formed by the process of stamping, the device being intended to secure plastering loosened by shrinking of the lath, etc., before it becomes cracked and disintegrated.

A combined towel, hat and paper rack has been patented by Mr. Elbridge L. Scribner, of Amesbury, Mass. (P. O. Box 98). It is a simple, inexpensive, and efficient device, consisting of a frame formed of end pieces of wood, connected by wooden slats on the back, and supporting three rods of metal or wood for receiving the articles to be held, the lower rod being designed for receiving a roller towel, and the upper rod being offset or cranked for convenience in placing articles on the lower rods.

NEW BOOKS AND PUBLICATIONS.

MINERAL RESOURCES OF THE UNITED STATES, CALENDAR YEAR 1885. Washington: Government Printing Office, 1886. Pp. 576.

This is a carefully compiled volume, giving the statistics for mineral products in the United States. Coal, coke, petroleum, and natural gas are first treated of; the metals, from iron to zirconium, come next. Under aluminum the work of Col. Frishmuth, of Philadelphia, and of the Cowles Smelting Company, of Cleveland, are noted. In view of the demand for zirconium pencils for the oxyhydrogen light, the section on the sources and preparation of the oxide, by Mr. David T. Ray, is of special interest. Other subjects treated are structural materials, abrasive materials (buhr stones, etc.), precious stones, fertilizers, glass materials, and, under many other headings, a complete review of the titular subject appears. We also note a section of much interest on mineral paints, by Mr. Marcus Benjamin, F.C.S. In it the preparation of barytes as an adulterant for paints is described at some length. In some instances an elaborate explanation of the classification of paints as adopted is given. In other cases it is entirely omitted. The first system is certainly preferable. A very full index closes the work. It can be had on application to the Director of the United States Geological Survey, Washington, D. C., the cost of printing and binding (40 cents) being at the same time remitted.

Business and Personal.

The charge for Insertion under this head is One Dollar a line for each insertion; about eight words to a line. Advertisements must be received at publication office as early as Thursday morning to appear in next issue.

Best tempering fluid known—Mercury, potash, and hydrochloral. $2.00 per gallon. Samples, 25c. Address Chemical Works, New Albany, Ind.

Hodges' universal angle union makes pipe connection at any angle. Rollstone Machine Co., Fitchburg, Mass.

To makers of water wheels, current wheels, and horizontal turbines—Please address W. H. Garlick, Calumet, Ohio.

Sphero! A new and original game; an out-door sport; unlike any other. Apparatus of wood, simple, inexpensive. Packed like croquet, and cost to manufacture about the same. Patent pending. Rights, etc. Address J. M. Hughes, Brooklyn P. O., N. Y.

The H. W. Johns Manufacturing Co., 87 Maiden Lane, N. Y., will send to any address in the United States, postage prepaid, a trial package of ¼ pound of asbestos wick packing and 1½ pounds of asbestos piston rod packing, on receipt of one dollar; or ¼ pound of asbestos wick packing and 3½ pounds of asbestos piston rod packing, on receipt of two dollars. Give address in full—name, town or city, county, and State. The H. W. Johns asbestos packings are the best and most economical made.

For Sale—Ivory button works. Large, well lighted building; 20 H.P. engine; capacity, 200 gross per day; doing splendid business; plenty of cheap labor. Price, only $3,000. Address T. Bergy, Caledonia, Mich.

Wanted—A pushing man, capable of taking charge of a shop for building engines. A fine chance for a skilled mechanic. Address, with references, etc., lock box 17, York, Pa.

Blake's Improved Belt Studs are the best fastening for Leather and Rubber Belting. Greene, Tweed & Co., 83 Chambers St., New York.

Wanted—Tool agents in shops. Outfit free. E. H. Randall & Co., 154 Lake St., Chicago, Ill.

Link Belting and Wheels. Link Belt M. Co., Chicago.

The *Railroad Gazette*, handsomely illustrated, published weekly, at 73 Broadway, New York. Specimen copies free. Send for catalogue of railroad books.

Protection for Watches.

Anti-magnetic shields—an absolute protection from all electric and magnetic influences. Can be applied to any watch. Experimental exhibition and explanation at "Anti-Magnetic Shield & Watch Case Co.," 18 John St., New York. F. S. Giles, Agt., or Giles Bro. & Co., Chicago, where full assortment of Anti-Magnetic Watches can be had. Send for full descriptive circular.

Woodworking Machinery of all kinds. The Bentel & Margedant Co., 116 Fourth St., Hamilton, O.

Guild & Garrison's Steam Pump Works, Brooklyn, N. Y. Pumps for liquids, air, and gases. New catalogue now ready.

Concrete patents for sale. E. L. Ransome, S. F., Cal.

The Knowles Steam Pump Works, 44 Washington St., Boston, and 93 Liberty St., New York, have just issued a new catalogue, in which are many new and improved forms of Pumping Machinery of the single and duplex, steam and power type. This catalogue will be mailed free of charge on application.

Presses & Dies. Ferracute Mach. Co., Bridgeton, N. J.

Nickel Plating.—Sole manufacturers cast nickel anodes, pure nickel salts, polishing compositions, etc. $100 "*Little Wonder.*" A perfect Electro Plating Machine. Sole manufacturers of the new Dip Lacquer Kristaline. Complete outfit for plating, etc. Hanson, Van Winkle & Co., Newark, N. J., and 92 and 94 Liberty St., New York.

Iron Planer, Lathe, Drill, and other machine tools of modern design. New Haven Mfg. Co., New Haven, Conn.

Supplement Catalogue.—Persons in pursuit of information of any special engineering, mechanical, or scientific subject, can have catalogue of contents of the SCIENTIFIC AMERICAN SUPPLEMENT sent to them free. The SUPPLEMENT contains lengthy articles embracing the whole range of engineering, mechanics, and physical science. Address Munn & Co., Publishers, New York.

Planing and Matching Machines. All kinds Wood Working Machinery. C. B. Rogers & Co., Norwich, Conn.

Billings' Drop Forged Steel C Clamps. Drop Forgings, all kinds. Billings & Spencer Co., Hartford, Conn.

Curtis Pressure Regulator and Steam Trap. See p. 45.

Chucks—over 100 different kinds and sizes in stock. Specials made to order. Cushman Chuck Co., Hartford, Ct.

The Improved Hydraulic Jacks, Punches, and Tube Expanders. R. Dudgeon, 24 Columbia St., New York.

Hoisting Engines, Friction Clutch Pulleys, Cut-off Couplings. D. Frisbie & Co., 112 Liberty St., New York.

If an invention has not been patented in the United States for more than one year, it may still be patented in Canada. Cost for Canadian patent, $40. Various other foreign patents may also be obtained. For instructions address Munn & Co., SCIENTIFIC AMERICAN patent agency, 361 Broadway, New York.

Veneer Machines, with latest improvements. Farrel Fdry. Mach. Co., Ansonia, Conn. Send for circular.

Tight and Slack Barrel Machinery a specialty. John Greenwood & Co., Rochester, N.Y. See illus. adv., p. 28.

Walrus, Bull Neck, and Buffalo Leather for polishing emery, glue, composition, Polishers' Supplies. Greene, Tweed & Co., New York city.

Catarrh Cured.

A clergyman, after years of suffering from that loathsome disease, catarrh, and vainly trying every known remedy, at last found a prescription which completely cured and saved him from death. Any sufferer from this dreadful disease sending a self-addressed stamped envelope to Dr. Lawrence, 212 East 9th St., New York, will receive the recipe free of charge.

Lick Telescope and all smaller sizes built by Warner & Swasey, Cleveland, Ohio.

Send for catalogue of Scientific Books for sale by Munn & Co., 361 Broadway, N. Y. Free on application.

Notes & Queries

HINTS TO CORRESPONDENTS.

Names and Address must accompany all letters, or no attention will be paid thereto. This is for our information, and not for publication.
References to former articles or answers should give date of paper and page or number of question.
Inquiries not answered in reasonable time should be repeated; correspondents will bear in mind that some answers require not a little research, and, though we endeavor to reply to all, either by letter or in this department, each must take his turn.
Special Written Information on matters of personal rather than general interest cannot be expected without remuneration.
Scientific American Supplements referred to may be had at the office. Price 10 cents each.
Books referred to promptly supplied on receipt of price.
Minerals sent for examination should be distinctly marked or labeled.

(1) L. M. W. asks (1) a receipt for marsh mallows, as made by confectioners. A. Dissolve one-half pound of gum arabic in one pint of water, strain and add one half pound of fine sugar, and place over the fire, stirring constantly until the sirup is dissolved, and all of the consistency of honey. Add gradually the whites of four eggs well beaten. Stir the mixture until it becomes somewhat thin and does not adhere to the finger. Flavor to taste and pour into a tin slightly dusted with powdered starch, and when cool divide into small squares. 2. The title of a good veterinary journal. A. *American Veterinary Review*, New York. 3. The formula for a spavin cure? A. Take of sweet oil 4 ounces, spirits of turpentine 2 ounces, oil of stone 1 ounce. Mix and apply three times per day. 4. A receipt for a wash that will prevent rabbits from injuring the bark of fruit trees. A. We know of nothing good for this purpose.

(2) A. L. K. asks how common fat can be rendered into tallow in an open kettle. A. Keep the tallow melted for some time, along with about two per cent of sulphuric acid largely diluted with water, employing constant agitation, and allowing the whole to cool slowly; then remelt the cake with a large quantity of hot water, and wash well.

(3) W. C. B. asks about the process and kind of machinery used in preparing raw sienna for paint. A. The raw sienna is thrown directly on the hearth of a reverberatory furnace and kept thoroughly raked until it assumes a proper color. Very little, if any, sienna is known to be burnt in this country.

(4) W. M. M. asks for some transparent paint suitable to paint on tracing muslin. A. You must use a transparent varnish such as the following: Dissolve 30 parts of copal and 2 parts of camphor in 120 parts of oil of turpentine and 30 parts of oil of lavender. Use lakes, gamboge, Prussian blue, and the other transparent colors, mixed with the vehicle.

(5) S. S. asks a receipt for black heads. A. Cover the parts afflicted with a pomade consisting of kaolin 4 parts, glycerine 3 parts, acetic acid 2 parts, with the addition of a small quantity of ethereal oil. See SUPPLEMENT, No. 542.

(6) W. L. asks (1) a cure for frost bitten feet. A. For frost bites, rub the affected parts with pure oil of peppermint. It will also prevent the after effect of chilblains. Care should be taken to use only the pure oil, and not the essence of peppermint, as the essence will not have the desired effect. 2. How plate glass is made. A. See SCIENTIFIC AMERICAN SUPPLEMENT, No. 340.

(7) A. T.—Hard rubber is a very good insulator; gutta percha is also very good, and can be softened by boiling water and given any desired shape.

(8) J. H. S. wants a good receipt to prevent hair coming out. A. Scald black tea, 2 ounces, with 1 gallon of boiling water, strain, and add 3 ounces glycerine, tincture cantharides ½ ounce, bay rum 1 quart. Mix well and perfume. This is a good preparation for frequent use in its effect both on the scalp and hair, but neither will be kept in good condition without care and attention to general health. See articles in SUPPLEMENTS, 102, 388, 396.

(9) A. H. asks the size of steel wire rope necessary to suspend a weight of 16,000 pounds, each end of the rope being fastened 1,600 yards apart, the weight to travel from one end to the other on the rope. A. The scheme of so long a span carrying a load is impracticable. A span of 4,800 feet will nearly absorb the margin of safety by its own weight, depending upon the amount of deflection that could be allowed in the catenary curve. The largest steel cables that are made, 2⅝ inches, weigh 13 pounds per foot, or over 31 net tons for your span; with a deflection of one twenty-fifth, or nearly 200 feet, the tension would be 3¼ times the weight, or 254,800 pounds, while the ultimate strength is but 400,000 pounds.

(10) G. A. L. asks: Why will a brake on the hind end of a train of cars hold more than a brake set ahead of it on train? A. We do not know that it is so. It is possibly a fancy.

(11) A. K. H. asks: Will hot air cool off by sending it rapidly through a wooden tube 300 or 400 feet long? If so, how much? A. Yes, slightly. An iron pipe is better if you wish to cool the air. How much the air will be cooled will depend on initial temperature and the temperature of the conductor and surrounding air.

(12) H. H. writes: I have large quantities of iron and steel to pickle, or, in other words, to clean. I use oil of vitriol, which is expensive and dangerous. Is there an acid that would be cheaper and at the same time as effective? A. We know of nothing cheaper or better than sulphuric acid for pickling castings. The most economical method, as practiced here, is found in the hot bath, a tub lined with lead, or if of small requirement a stone pot. Water 5 to 8 parts, acid 1 part. Boil the work in the acid bath for a few minutes, then rinse in hot water. There is no danger

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if properly managed. For wrought iron and steel, use hydrochloric acid and water.

(13) W. F. E. asks: 1. How are bath bricks made? A. Bath bricks are fonnd native as minerals, and are imported from England. 2. How are papier mache ornaments moulded, and where can I procure a work on the subject? A. We can send you Spons' "Workshop Receipts" for $2.00, first series, which contains full information on papier mache. See also various articles in SCIENTIFIC AMERICAN SUPPLEMENT on the technology of the paper trade.

(14) W. M. S. asks how to make liquid glue. A. Take a wide mouthed bottle, and dissolve in it 8 ounces best glue in ½ pint water, by setting it in a vessel of water, and heating until dissolved. Then add slowly 2½ ounces strong nitric acid 36° Baume, stirring all the while. Effervescence takes place, with generation of fumes. When all the acid has been added, the liquid is allowed to cool. Keep it well corked, and it will be ready for use at any time.

(15) E. H. F. asks what preparation steam laundries use to make their goods so stiff and have such a fine gloss, and how is it used, and, if used with starch, is hot or cold starch used? A. Melt 2½ pounds of the very best A 1 paraffine wax over a slow fire. When liquefied, remove from the fire and stir in 100 drops oil of citronella. Have a lot of round new pie tins, clean and nice; place them on a level table, coat them slightly with sweet oil, and pour about six tablespoonfuls of the enamel into each tin. The pan may be floated in water to cool the contents sufficiently to permit the mixture to be cut or stamped out with a tin cutter into small cakes about the size of a peppermint lozenge. Two of these cakes added to each pint of starch will cause the smoothing iron to impart the finest possible finish to muslin or linen, besides perfuming the clothes.

(16) J. T. M., Jr., asks for a tempering liquid for tempering a flat coiled spring, ⅛ of an inch thick, 1½ inches wide, 20 feet long, without drawing the temper. A. You can get a spring temper in the hardening bath. Harden in water or oil and draw temper in an iron pan of linseed oil at boiling temperature.

(17) C. E. H. writes: I have nearly 1,000 feet of out-door steam pipe carried in elevated wooden boxes. What is a good and cheap pipe covering to prevent loss of heat? A. Pulverized charcoal or sawdust makes a good cheap insulation for steam pipes. The boxes should be large enough to allow 2 inches clearance all around the pipe, the latter to be retained in position by cleats. Boxes should be tight enough to prevent circulation of air. Tar the outside to make weather proof.

(18) B. L. asks: 1. Is there any method for removing rust stains from white cloth or linen? A. See the table in SCIENTIFIC AMERICAN SUPPLEMENT No. 158, for the "Removal of Stains and Grease Spots." 2. Is there any book showing how to work out chemical problems, and giving answer in the back of the book? A. Professor J. P. Cooke's "Chemical Problems and Reactions" can be sent you postpaid for $1.

(19) D. B. wants a receipt for a dark cherry stain for a white pine floor. A. Use rain water 3 quarts, annatto 4 ounces; boil in a copper kettle till the annatto is dissolved, then put in a piece of potash the size of a walnut; keep it on the fire about half an hour longer, and it is ready to bottle for use.

(20) J. T. S.—Engines with automatic cut-offs will run steady with variable work. If you have a governor that only controls a throttle valve, there will be a small variation of speed with as much variation in the work as you state. Much depends upon the relative amount of work absorbed by the mill and the variable machinery.

TO INVENTORS.

An experience of forty years, and the preparation of more than one hundred thousand applications for patents at home and abroad, enable us to understand the laws and practice on both continents, and to possess unequaled facilities for procuring patents everywhere. A synopsis of the patent laws of the United States and all foreign countries may be had on application, and persons contemplating the securing of patents, either at home or abroad, are invited to write to this office for prices, which are low, in accordance with the times and our extensive facilities for conducting the business. Address MUNN & CO., office SCIENTIFIC AMERICAN, 361 Broadway, New York.

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February 8, 1887,

AND EACH BEARING THAT DATE.

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FORTY-SECOND ANNUAL REPORT

OF THE

NEW YORK LIFE INSURANCE COMPANY

Office: Nos. 346 & 348 Broadway, New York.

JANUARY 1, 1887.

Amount of Net Cash Assets, January 1, 1886 ..... $63,512,618.00

REVENUE ACCOUNT.

Premiums	$16,386,067.69	
Less deferred premiums, January 1, 1886	878,161.65—	$15,507,906.04
Interest and rents, etc. (including realized gains on Securities sold)	4,157,786.42	
Less Interest accrued January 1, 1886	435,284.18—	3,722,502.24—$19,230,408.28
		$82,743,026.28

DISBURSEMENT ACCOUNT.

Losses by death, including reversionary additions to same		$2,757,035.97
Endowments, matured and discounted, including reversionary additions to same		559,075.01
Dividends, annuities, and purchased policies		4,311,119.11
Total Paid Policy-holders	$7,627,230.09	
Taxes and re-insurances		243,142.84
Commissions, brokerages, agency expenses and physicians' fees		2,529,357.57
Office and law expenses, salaries, advertising, printing, etc.		523,672.30—$10,923,402.80
		$71,819,623.48

ASSETS.

Cash in bank, on hand, and in transit (since received)		$3,033,305.13
United States Bonds and other bonds and stocks (market value, $43,124,273.88)		39,522,445.99
Real Estate		6,339,974.22
Bonds and Mortgages, first lien on real estate (buildings thereon insured for $14,000,000 and the policies assigned to the Company as additional collateral security)		15,228,775.00
Temporary Loans (market value of securities held as collateral, $5,912,741)		4,450,000.00
*Loans on existing policies (the Reserve held by the Company on these policies amounts to over $3,000,000.00)		408,619.44
*Quarterly and semi-annual premiums on existing policies, due subsequent to Jan. 1, 1887		1,041,666.15
*Premiums on existing policies in course of transmission and collection. (The Reserve on these policies, included in Liabilities, is estimated at $1,050,000)		646,437.14
Agents' balances		161,905.31
Accrued Interest on investments, January 1, 1887		486,497.10—$71,819,623.48
Market value of securities over cost on Company's Books		3,601,829.89

*A detailed schedule of these items will accompany the usual annual report filed with the Insurance Department of the State of New York.

CASH ASSETS, January 1, 1887, - - - $75,421,453.37

Appropriated as follows:

Adjusted losses, due subsequent to January 1, 1887		$202,346.43
Reported losses, awaiting proof, etc.		355,625.28
Matured endowments, due and unpaid (claims not presented)		37,890.70
Annuities due and unpaid (uncalled for)		9,318.74
Reserved for re-insurance on existing policies; participating insurance at 4 per cent. Carlisle net premium; non-participating at 5 per cent. Carlisle net premium		62,525,599.00
Reserved for contingent liabilities to Tontine Dividend Fund, January 1, 1886, over and above a 4 per cent. Reserve on existing policies of that class	$3,123,742.77	
Addition to the Fund during 1886	1,320,530.69	
	$4,444,273.46	
DEDUCT— Returned to Tontine policy-holders during the year on matured Tontines	267,848.21	
Balance of Tontine Fund, January 1, 1887		4,176,425.25
Reserved for premiums paid in advance		33,720.72
		$67,340,926.12
Divisible Surplus (Company's Standard)		8,080,527.25
		75,421,453.37

Surplus by the New York State Standard at 4½ per cent. (including the Tontine Fund), $15,549,319.53

From the undivided surplus of $8,080,527.25 the Board of Trustees has declared a Reversionary dividend to participating policies in proportion to their contribution to surplus, available on settlement of next annual premium.

Death Claims paid.	Income from Interest.	Insurance in force.	Cash Assets.
1882, $1,955,292	1882, $2,798,018	Jan. 1, 1883, $171,415,097	Jan. 1, 1883, $50,800,396
1883, 2,263,092	1883, 2,712,863	" 1884, 198,746,043	" 1884, 55,542,902
1884, 2,257,175	1884, 2,971,624	" 1885, 229,382,586	" 1885, 59,283,753
1885, 2,999,109	1885, 3,399,069	" 1886, 259,674,500	" 1886, 66,864,321
1886, 2,757,035	1886, 3,722,502	" 1887, 304,373,540	" 1887, 75,421,453

Number of Policies issued during the year, 22,027. Risks assumed, $85,178,294.

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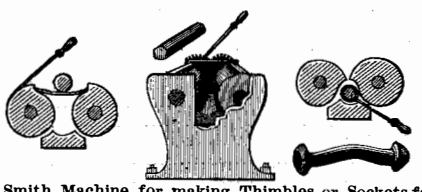

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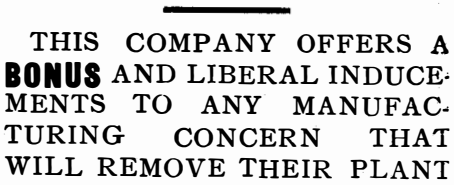

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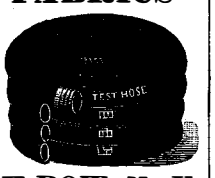

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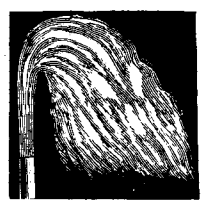

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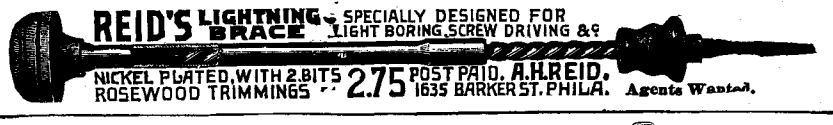

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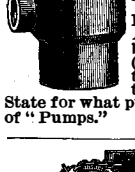

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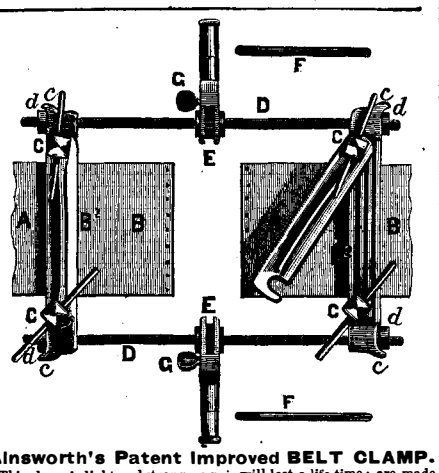

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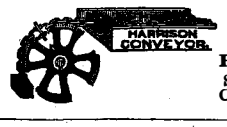

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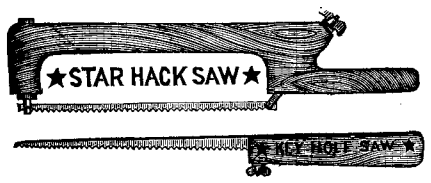

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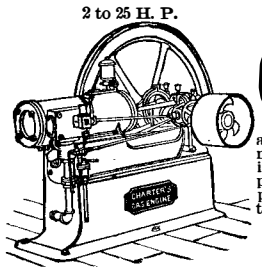

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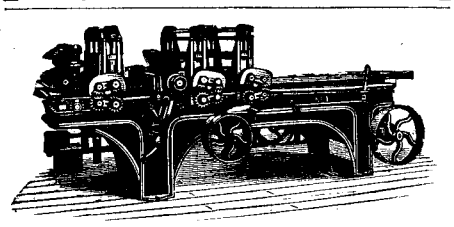

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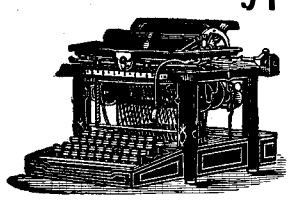

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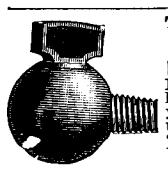

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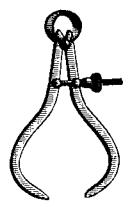

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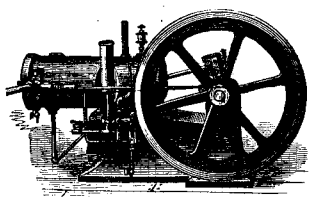

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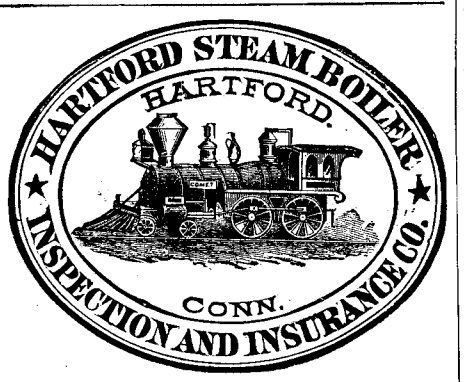

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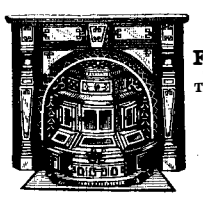

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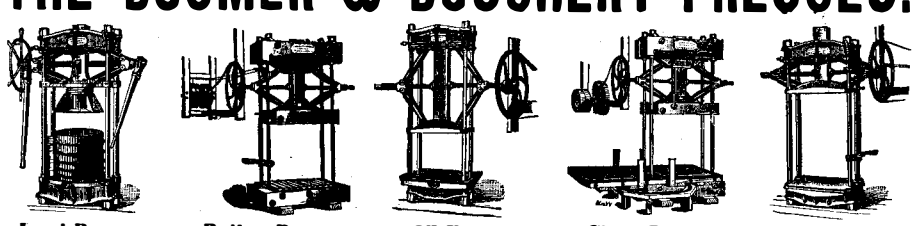

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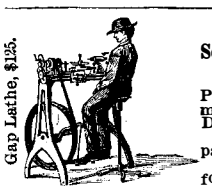

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